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PART I

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
CANADA 1962

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1960
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NATIONAL MUSEUM OF CANADA
Bulletin No. 180

ANTHROPOLOGICAL SERIES NO. 57

CONTRIBUTIONS TO ANTHROPOLOGY, 1960
PART I

**Issued under the authority of
The Honourable Walter Dinsdale, P.C., M.P.
Minister of Northern Affairs and National Resources**

**DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
OTTAWA 1962**

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FOREWORD

Publication of "Contributions to Anthropology, 1959" (National Museum of Canada Bulletin No. 173) eliminated the last backlog of anthropological studies that had accumulated since the Annual Reports of the National Museum of Canada were discontinued in 1956. Beginning with the present volume, the "Contributions" will consist almost entirely of work done or completed in the year designated. However, the expanding programme of anthropological research of the National Museum of Canada has produced for 1960 a larger number of reports than could be included conveniently in one volume. The "Contributions to Anthropology, 1960," therefore, is appearing in two parts, the first and present volume being devoted to archaeology and physical anthropology, and the second to ethnology, linguistics, folklore, and general subjects. It seems probable that the amount of publishable material resulting from the Museum's programme in the various anthropological sciences will be for some years so large as to require the two-volume format for "Contributions to Anthropology."

Since the papers comprising this volume were submitted, Mr. Lowther has completed a second successful season on Devon Island, the results of which are being prepared for publication by the Museum. Dr. Maxwell is planning to undertake large-scale excavations in the vicinity of Lake Harbour, Baffin Island, again with the support of the National Museum of Canada. Mr. Wright has submitted a report on the Donaldson site, a Middle Woodland component in southwestern Ontario. This, with Dr. Anderson's nearly completed analysis of the skeletal material from the site, will comprise a Museum Bulletin. Dr. Anderson is also preparing a report on the human skeletal remains of the Fairty site, an Iroquois ossuary near Toronto, Ontario. The reports by Messrs. Merbs and Wilson, and by Dr. Chown and Miss Lewis on the Eskimo of Southampton Island, N.W.T., present part of the results of a University of Wisconsin expedition that chose Southampton Island as an area of research on the advice of National Museum of Canada archaeologists. The Museum is especially pleased to publish these results, for they add to the Southampton Island studies already offered in Bulletins 142, 147, and 162. Dr. Anderson's work entitled "The Human Skeleton: A Manual for Archaeologists" is being printed and should prove a most useful tool for both field and laboratory. A new series entitled "Anthropology Papers" is being started to permit rapid publication of short reports. The first of these, "Fraser River Archaeological Project," by Dr. C. E. Borden, should appear well in advance of the present volume. Dr. R. S. MacNeish, Senior Archaeologist of the Museum, is completing a large report on the archaeology of Yukon Territory, and W. E. Taylor, also of the Museum staff, is finishing a similar work on the Hudson Strait region. Both of these will appear as Museum Bulletins.

In the next fiscal year the National Museum also hopes to publish reports by Dr. J. N. Emerson of the University of Toronto and Major J. Pendergast of Ottawa on an Iroquois site in southeastern Ontario. In the near future the Museum will receive from Dr. William Mayer-Oakes, University of Oklahoma, and Mr. Zenon Pohorecky, University of California, a full report on the extensive archaeological work sponsored by the Museum in the Saskatchewan River valley. Finally, Dr. Elmer Harp of Dartmouth College will prepare for publication a summary analysis of the Boreal Archaic culture of Newfoundland, incorporating results of his recent field work there. Other studies on the prehistory of Ontario, Quebec, and New Brunswick are under way, along with additional work on the physical anthropology of Canadian Indians and Eskimos.

The research programme of the National Museum of Canada in archaeology and physical anthropology is designed primarily to provide a balanced coverage of these subjects in various parts of Canada, but it is also intended to assist the research and training programmes of Canadian universities.

L. S. RUSSELL
Acting Director,
Human History Branch

OTTAWA, December 1961.

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AN ACCOUNT OF AN ARCHAEOLOGICAL SITE ON CAPE SPARBO, DEVON ISLAND

BY G. R. LOWTHER*

In the summer of 1960 the Arctic Institute of North America sent an expedition to Devon Island for the first season of a proposed four-year project. The 1960 season was one of reconnaissance and preparation, and a preliminary account of the work of the expedition as a whole has already been published by its field-leader, S. Apollonio (Apollonio 1961), who also provided the information for a summary of the work that has appeared anonymously elsewhere (Anon. 1960). The archaeological party consisted of R. S. McCall and G. R. Lowther, augmented for a part of the time by D. Oliver[1]. The principal concern in this article is with a part of the material obtained by preliminary investigation of a site found on Cape Sparbo. The site contains pre-Dorset, perhaps some Dorset, and Thule material, but only the pre-Dorset and the few possibly Dorset artifacts will be reported on in any detail here. Some test excavations of the Thule ruins were made, but the artifactual material thereby obtained is not available to the author at the time of writing. The site was discovered in the course of a short flight made by helicopter on the day the expedition landed on the island. The expedition's base camp was established about twenty-two miles southwest of Cape Sparbo; McCall, Oliver, and the author then walked to the site and spent five working days there.

The site is at the end of Cape Sparbo, on the north coast of Devon Island. Its geographical co-ordinates are 75° 50′ N. by 83° 55′ W. It borders the waters of the bay which lies between capes Sparbo and Skogn and to which the name 'Skogn Bay' has been tentatively assigned (*see* sketch map and inset on page 3[2]). The bay is itself a part of the larger body of Jones Sound.

The place-names of the area, i.e., the Cape Sparbo area, could be a source of some confusion. Sparbo is the more westerly of two capes, the eastern one, about three miles from Sparbo, being Cape Hardy[3]. From a distance, the two capes appear to be islands, a point remarked upon by F. Cook, who wintered at Cape Hardy in 1908–9 (Cook 1911). The capes are joined to each other and the mainland by a stretch of low-lying, lake-studded land.

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*McCord Museum, McGill University.

[1] My thanks are due to many people who have helped with the archaeological work as a whole and in the preparation of this article: To the Governing Body of McGill University and to Mrs. A. J. Turnham, Director of the McGill University Museums, for permission to take part in the Expedition. To the Governors of the Arctic Institute of North America for the opportunity to take part in the work and for permission to publish the results. To S. Apollonio for the generous way in which he met my requests and furthered the archaeological work of the Expedition. To other members of the Expedition who helped in excavation and reconnaissance at various times, particularly B. Clarke, V. D. Boyd, and R. Harrington. To J. Hamilton, pilot of the helicopter of the C.G.S. *d'Iberville*, on a flight with whom the site reported on here was discovered. Especially to R. S. McCall, the other full-time member of the archaeological party, and D. Oliver, without whose great help the work could not have been done. To W. E. Taylor of the National Museum of Canada, E. Harp of Dartmouth College, and J. Meldgaard and H. Larsen, of the National Museum of Denmark, for their most helpful examination and discussion of the archaeological material obtained. And to J. Rosing, of the National Museum of Denmark, who re-drew the sketch map for publication.

[2] The reason for the choice of a 40-foot form-line interval on the sketch map, rather than a more common measure, is as much a mystery to the author as it probably is to the reader. At the time that the map was drawn no doubt there was some good reason for the choice being made, but its significance has eluded both the author's notes and his memory.

[3] This usage is in conformity with the 1959, Fourth Revised edition of the Canadian Topographic System 1:500,000 map.

The possibility of confusion stems from the circumstances of the names of the two capes having been exchanged on some maps, whilst on others the two capes have been marked under one name only, sometimes Hardy and sometimes Sparbo. The possibility is compounded by the further circumstance of the only other recorded excavation on the island having been made at a site on Cape Hardy. That site is of a Thule-Dorset character and was excavated by T. C. Lethbridge in 1937 (Lethbridge 1939). It was in a reconstructed house of the Cape Hardy site that Cook lived in 1909–10. To guard against the possibility of confusion between the Sparbo and Hardy sites, an individual name has been given to the site on Cape Sparbo. The site has been named 'Inavik,' meaning 'the place where a fire was made,' i.e., a settlement. The provision of an individual name also allows for other sites being found on or near Cape Sparbo.

The site stretches about half a mile and extends from the end of Cape Sparbo along its southwest side, occupying the narrow strip of relatively level ground that forms the footing of the cape. On its seaward side, the site is bounded by the rocky foreshore. It is backed by the steeply-rising mass of the cape, the sides of which are covered with large boulders. The eastern boundary of the site is at a place where the steep hillside goes straight down to the sea, at one point forming a cliff, without the interruption of a level foot. Nowadays, in the summer months at least, it is necessary to scramble over the hillside and cliff to reach the site when it is approached by land. The western margin of the site is the point of the cape (and is not shown on the accompanying map).

On a physiographical basis, the site can conveniently be divided into three parts. The easterly part extends about 450 yards from the eastern limit of level footing to a point where the steep hillside goes almost straight into the sea, the narrow footing at that point forming a neck between the eastern and central parts of the site. The eastern part is the widest part of the site, but even so, and at its widest part, its width is something less than a hundred yards. It also carries more vegetation than the rest of the site, a cover that consists principally in short grass but which at some points, such as the foot of run-off courses, is rather more lush. However, the eastern part is not entirely covered with grass. In places, particularly on the seaward side, bare rock forms the surface. At what is approximately the mid-way point of the eastern part the ground is a little higher than it is on either side: this 'crown,' marked as Area A on the sketch map, is an area surfaced with fine gravel and fine pebbles, as is the slightly lower area marked on the map as Area C. The eastern part of the site is also relatively free from large boulders. Such soils as have developed, i.e., in the areas covered with grass, are usually shallow and appear always to rest on beach sands.

The central part of the site stretches about 250 yards from the western margin of the eastern part towards the point of the cape. It is generally

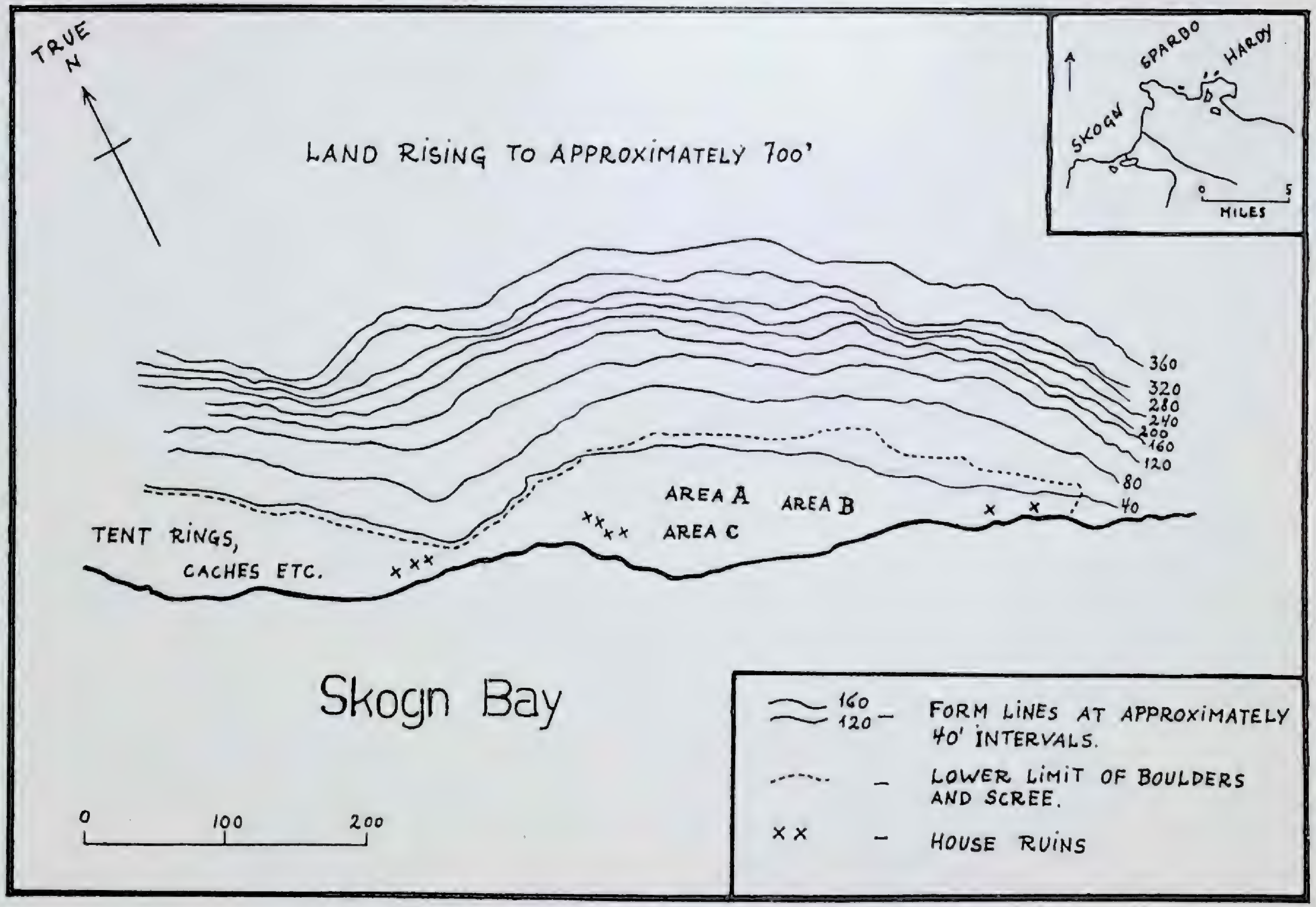

Figure 1. Sketch map of part of the Inavik site, Cape Sparbo.

a little lower than the eastern part, and has a much more sparsely distributed growth of vegetation. The surface is mostly gravel, pebbles, and sand, with bare rock in many places. Only at the eastern end of this part, contiguous with the eastern part of the site, is there any considerable covering of grass.

The western part of the site, not shown on the accompanying sketch map, extends from the central part to the point of the cape. As the point of the cape is approached, those areas of the ground surface formed by bare rock become more extensive, until at and around the point the surface is one of continuous rock slabs on which boulders of all sizes are distributed haphazardly. Towards the point, the relatively level footing rapidly diminishes in breadth. At the tip it disappears where the southern meets the northern side of the cape, which latter is also boulder-strewn but which falls straight to the sea and has no real footing.

So far as could be seen in the time spent there in the late summer of 1960, there is no permanent source of fresh water on the site itself. A half mile inland from the eastern margin of the site, as it were at the back of the cape, there are numerous small freshwater lakes, most of them only a few feet above sea-level. There are also numerous run-off courses on the sides of the cape above the site.

The distribution of the various kinds of archaeological material on the site coincides to a considerable degree with the, admittedly rather crudely designated, physiographical divisions. The western part of the site appears to contain little archaeological material, that which does exist consisting mainly in a number of stone 'markers' on the seaward edge and a few stone caches. Almost at the point of the cape, however, there is a rather unusual construction. Close to a very large and finely-balanced boulder there is a long and narrow structure, its walls and roof made of roughly-laid stone courses. The approximate exterior measurements are 12 feet for the length by 5 feet by 5 feet. The walls are very thick, and, with the exception of the length, the interior dimensions are much smaller than the exterior, the interior height being only about 3 feet and the width 2 feet 6 inches. At one end the walls are rounded and joined to close the structure, whilst the other end, forming a lintelled doorway, is open and faces the sea. Half-way along one side a small 'window' space has been left. Above and parallel to the main passage, which is all in what the structure really consists, there is a smaller vent, about 10 inches wide by 5 inches high. The floor is the original ground surface, and the general effect is of an above-ground entrance passage without a house—a tail without a dog. Inquiries made of many persons have not resulted in a satisfactory definition of what the structure might be, and suggestions have covered a wide range[1]. It is hoped that more detailed examination, in the course of further work on the site, will enable more to be found out about the situation.

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[1] One of the suggestions is that the structure was built by some of the whalers who frequented the Sparbo-Hardy area at the end of the nineteenth century, or that it might be a house or temporary shelter built by someone who had not the means or knowledge to roof a building of more conventional shape. If this is correct, the house must have been a most uncomfortable one, as it is almost impossible to turn around in it. Another suggestion, made by J. Rosing of the National Museum of Denmark, is that the structure might be a smoke house of some kind, a suggestion supported by the presence of the vent above the main passage. The possibility that the structure is of Norse origin, whilst perhaps encouraging to Viking enthusiasts, is one that the author does not care, or feel competent, to contemplate.

The site as a whole contains nine house ruins, and further investigation may possibly reveal more. Of the nine houses, six are in the eastern part of the site, and three are at the eastern end of the central part. From the surface indications, of projecting whale bone supports and of ground plans, and on the evidence obtained by limited test excavations, the houses appear to be of a Thule character. Two of the houses, in the group of four at the western end of the eastern part of the site, do show certain indications of being rather older than the others. One of the two may be a double house, as it appears to have two entrance passages. The two houses are at a slightly greater height above sea-level than the houses in other parts of the site. However, the characteristic is shared to almost the same extent by the other two houses in the group and in any event is of possible significance only if it should be proved that there has been a fall in sea-level on that stretch of the Devon Island coast. The two houses in question are also less clearly outlined than the others on the site, their remnant walls appearing only as low mounds, and there is no whale bone protruding from them.

In addition to the three house ruins at its eastern end, the central part of the site contains certain archaeological remains which are either rare or absent in the two other principal parts of the site. There are numerous tent rings, made of single circles of stones; stone caches of various sizes, most of them well constructed and in good repair; 'markers' and/or the remains of kayak supports along the seaward edge; stone traps and, possibly, an open fireplace, and numerous groups of stones and small boulders whose positions are clearly contrived but whose significance is not thereby clearly indicated.

The eastern part of the site contains the group of four houses already mentioned, and, at the far end of the site by its eastern margin, two other houses. The most easterly of the latter is the closest to the sea of any of the houses on the site, being built on the slope immediately above and almost at the water's edge. In the same house a large wooden beam lies the length of the entrance passage. The other house is the largest and most upstanding of those on the site; as is the case with its neighbour, there is a considerable amount of whale bone in its walls. By a process of rather obvious, and hence probably rather suspect, inference it is not difficult to reach the opinion that these two houses may be of a more recent construction than others on the site.

From those areas of the eastern part of the site marked as B and C on the sketch map—areas which are without soil cover and are surfaced with gravel and small pebbles, with some growth of lichen—surface collections of pre-Dorset and perhaps some Dorset material were made. Area A, covered with grass and with a soil cover of between 4 inches and 6 inches in thickness, contained pre-Dorset material in direct association with quantities of faunal material, some of it burned. The artifactual and faunal material occurred at the junction of the soil with the underlying sand and gravel. The junction is slightly convoluted and is marked in some places by grey, ash-like lenses, around and in which the artifacts generally occur. No artifacts or fragments were found on the surface of Area A. All the artifacts and artifactual fragments so far found in the three areas are lithic. Those from Area B, 49 in number, and the seven pieces from Area C, were distributed rather widely over several square yards but occurred sometimes in small nuclei. In those two areas the material was always effectively on the surface, none occurring below that level, and, as might be expected from its exposed position, was not associated with any faunal material. The artifacts and fragments from Area A, totalling 28 pieces and associated with the considerable amount of faunal material, were found in an area 3 feet by 4 feet in dimensions. A cursory examination of the faunal material indicated the presence of seal, fox, and what are probably caribou remains.

For the reasons given earlier in this article, only the material from Areas A, B, and C, i.e., the pre-Dorset and the small amount of possibly Dorset material, can be described here. The total number of artifacts and artifactual fragments from the three areas is 84, of which 12 pieces can be given a designation no more specific than that they are worked pieces, debris or blanks. The remainder and body of the objects comprises points, knives, side blades, end blades, microblades, burins, and burin spalls.

The artifactual designations used below are essentially pragmatic and heuristic, and the criteria of designation are not held to be formally consistent. To attempt a formal classification of so small a series would be both pretentious and methodologically dubious.

The points and blades and fragments thereof, other than microblades, are 18 in number. Of that number some are clearly projectile points; others are as likely to be knife blades. One example is a crescentic side blade, another an end blade, but the terms 'point,' 'blade,' 'end blade,' 'side blade,' and 'knife blade' are not taxonomically consistent; they refer to overlapping rather than to discrete classes. The functional attributes of some of the artifacts cannot be precisely stated.

The artifact shown as No. 1 in Plate I is a finely worked projectile point. It was found in Area A, and is made of dark grey chert. The actual tip and one corner of the base are broken off. Its length is 2.45 cm, its breadth .90 cm, and its thickness .17 cm[1]. The general outline of the point is triangular, the sides being slightly convex and the base slightly concave. The side edges are very finely serrated, and the base has been thinned by chipping. The working is bifacial by means of almost horizontal chipping. A slight median ridge has been left, and appears to have been rubbed a little. The cross-section is a slim lozenge in shape. The artifact seems clearly to be of a pre-Dorset and Arctic Small Tool character; if artifactual examination were olfactory, it might be said that it has a 'smell of the West.' Serration, for example, was noted on some of the Denbigh Flint Complex artifacts, although admittedly on double-pointed examples of what J. L. Giddings has called 'plano-convex blades' (Giddings 1951: Figure 61a, Nos. 5 and 6). At the same time and, of course, more in accord than at odds with the opinion of Western affinity, the artifact is similar to points found in Sarqaq horizons in West Greenland (*see* Larsen and Meldgaard 1958: Plate 4, Nos. 10 to 14, inclusive). There is also perhaps some similarity, in mode of manufacture and in serration, between the point described here and some of those found at the Dismal-2 site and reported on by E. Harp (Harp 1958: Figure 6, gp. 2). A number of the points from the earlier pre-Dorset phases of Igloolik are also similar to the one shown here (Meldgaard, J.: pers. comm.). Strengthening the possibility of affinity with Western Arctic material is the similarity between the point described here and two points, one in particular, illustrated in one of R. S. MacNeish's reports on the Engigstciak site in the northern Yukon. The point shown as No. 4 in Plate VII of that report (MacNeish 1959), appears to be very similar to the one found at Cape Sparbo, whilst the latter is also similar to the one shown as No. 5 in Plate VI of the same report. Only the similarities between the artifacts are remarked upon here: no implications of correlation or connection, necessary or otherwise, are made.

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[1] In the description of the artifacts, the length given is that of the longitudinal axis; the breadth is the maximum measurement of any part of the artifact at right angles to the longitudinal axis; the thickness is the maximum measurement of any part of the artifact at right angles to the breadth, but not necessarily along the line of the longitudinal axis. In general, the lengths of artifactual fragments are not given.

Serration is a feature of a number of the points and blades in the assemblage, and has been executed to varying degrees of delicacy and decisiveness. A broken blade, not shown here, is similar in the sophistication of its manufacture and in its determinable dimensions to the one shown in Plate I as No. 1, although its sides are more concave and the material of which it is made is more coarse. The two pieces shown in Plate I as Nos. 2 and 3 might be projectile points but are preferably referred to simply as blades. Both have been cleanly snapped at both ends. One of them, No. 3, is slightly curved, and both are made of dark grey chert. They were found in Area A. They are, however, less finely made than the point illustrated as No. 1 and are a good deal larger. The two are bifacially worked and show a median ridge; as they are broken, their dimensions are not of specific significance, but No. 2 is 1.25 cm in breadth by .42 cm in thickness, and No. 3 measures 1.34 cm by .52 cm. Their cross-sections are roughly lozenge-shaped. The serration on their edges is fairly coarse, but it is evenly developed on both edges of each artifact. Furthermore, in both cases the serration does not extend along the whole length of the edges, but it starts at the same point, i.e., at points opposite each other, of the edge of each artifact. The two pieces are similar to one shown by Giddings in his report on a site on the North Knife River (Giddings 1956: Figure 80, No. 11), but in accord with the criteria specified by Giddings in that article, the even development of their edges precludes the two artifacts from being classed unequivocally as side blades. Nor do they meet two of the other requirements used by Giddings as criteria for the designation of side blades. One of them, however, that labelled as No. 3, is asymmetrical. As Miss Stein might have written, 'blade is a blade is a blade is a blade.'

Another artifactual fragment which is best classed simply as a blade is that shown as No. 4 on Plate I. Even in its broken form, the angles of its sides with its presumed axis indicate an asymmetrical shape, but that alone is not a sufficient condition of its being classed as a knife. Its edges are slightly convex, and there are incipient serrations on one edge near the tip. It is mainly unifacially worked, but on the under surface not visible in the photograph and again only at the tip, it has been worked. It is rather slim, being only .20 cm thick, but the missing part was probably thicker. The artifact is made of the same material as the projectile point described above and shown as No. 1, Plate I, and was also found in Area A. Its cultural province could be almost anywhere in the pre-Dorset/Dorset range.

Seven other blades and parts of blades from Areas A, B, and C are shown in Plate I, Nos. 13 to 19, inclusive. The crescentic side blade, No. 13, is made of medium grey chert and was found in Area B. It is bifacially worked, and the arcuate edge, especially the underside (not shown in the photograph), has been thinned more effectively, by flaking at right angles to the arc, than has the other edge. There are signs of wear, particularly along the arcuate edge. The length of the artifact is 2.87 cm, its breadth 1.05 cm, and its thickness .22 cm. The criteria for insert side blades listed by Giddings in his report on the North Knife River material (Giddings 1956: p. 262), are met exactly. Of the individual specimens illustrated by Giddings, those shown as Nos. 5, 6, and 13 in Figure 78 of his report are most similar to the artifact described here. The latter is also similar to examples of a Sarqaq provenance (*see* Meldgaard 1952, especially Figure 76, No. 11, and relevant text on p. 223), and to some of the Ipiutak specimens listed as 'side-blades for knives' (Larsen and Rainey 1948: Plate 12, Nos. 16 and 17), although the latter are larger than the Cape Sparbo blade.

The specimen shown as No. 14 in Plate I is one on which little comment can or need be made. It is a broken blade, perhaps intended to serve as a knife. Both faces are worked, and one edge is trimmed by horizontal chipping more than the other. It was found in Area C, and is made of medium grey chert. Next to it in Plate I (No. 15) is the basal part of a large blade, 2.40 cm wide and .45 cm thick, made of a dark grey chert. The cross-section is lenticular, whilst the complete implement may have had a bayonet-like outline. It was found in Area B. The horizontal bilateral working has not left a real median ridge. The line of the base itself is slightly concave, and the base has been thinned by primary and secondary working. Similar examples to this blade, treated as an individual type and not as part of a congeries, could be found in many assemblages. It has little individual diagnostic value and can be used only as support to a statement of cultural affinity postulated upon other grounds.

The specimens shown in Plate I as Nos. 16, 17, 18, and 19 are the four pieces from the site which might be of a Dorset province. Some other specimens, for example some of the microblades, would not be out of place in a Dorset context, but they would not of themselves necessarily indicate such a context. The four specimens marked 16, 17, 18, and 19 do not necessarily imply a Dorset context, but the probability of that affinity is increased when it is considered in conjunction with the known existence of Dorset sites in the general geographical area. Moreover, the Dorset material from the nearest of those sites, the Thule-Dorset site at Cape Hardy, is presumably rather late in the Dorset sequence; one at least of the four artifacts considered here, that shown as No. 18, is matched by similar artifacts in late Dorset contexts elsewhere. On the other hand, none of the four artifacts would be anomalous in a pre-Dorset context.

The tanged base of a knife or scraper, No. 16, made of a medium grey chert, was found in Area A. As the artifact is broken, it is difficult to say whether in its original form it was equipped with an expanded rectangular base or with side notches, but the latter form seems the more probable. The working is bifacial, whilst the straight, sharp basal edge is thinned by secondary chipping and trimming. The piece is similar to some found by H. B. Collins at the T-1 site on Southampton Island and shown, *inter alia,* as Nos. 35 and 38 in Plate VI of a report on that site (Collins 1956).

The fragment shown as No. 17 seems likely also to have been the basal part of a blade. Made of a white and opaque quartzite, it was found in Area C. The basal edge is sharp and almost straight, and the angle between it and the sides is about 90 degrees. The working is bifacial, and there are some signs of rubbing on both faces. The artifact is similar to, although rather more finely made than, specimens found at the T-1 site (*see* Collins 1956: especially No. 15 in Plate VI).

The tanged end blade, probably used as a scraper and shown as No. 18 in Plate I, is of a kind known from late Dorset sites in the Canadian Arctic and is similar to others found in Greenland. It was found in Area C, and is 2.92 cm long, 1.91 cm wide, and .43 cm thick. The material of which it is made is a black silicified stone, slate-like in its appearance and to the touch. Working is principally upon the upper surface, shown in the photograph, although there is a little trimming, on one edge just above the notch and on the other edge below the notch, on the under surface. On the upper face, all the edges except that of the base are trimmed, the trimming being very steep on the top, convex, edge. Except for the little working on the under surface of the tang, the base has not been trimmed. No part of the artifact has been rubbed or ground; that which might appear in the photograph as a rubbed surface, in the centre of the upper face, is the original and outer surface of the piece of stone from a flake of which the end blade was made. The artifact can be matched by examples found on the Alarnerk site, Igloolik (Meldgaard, J.: pers. comm.) where they occur in a late Dorset horizon. It must be admitted, however, that similar end blades have been found in pre-Dorset assemblages on Jens Munk Island (Meldgaard, J.: pers. comm.) and in Ungava (Taylor, W. E.: pers. comm.).

The form of the blade shown as No. 19 in Plate I also permits only an equivocal inference of a Dorset context to be made. It is a projectile point, its tip broken, measuring 3.02 cm by 2.19 cm by .38 cm, made of a heavily patinated and lightly coloured chert or quartzite. It was found in Area B. The general outline of the point is trianguloid, with the sides and base slightly convex. The working is principally unifacial, only the upper face showing over-all working, but all three edges have been trimmed on both faces. Although its Dorset origin is equivocal, the point is matched quite closely by some of those found at the T-1 site (*see* Collins 1956: Plate V, especially No. 33), and not so well by those of the Denbigh Flint Complex with which Collins compares the T-1 points (*see* Collins, ibid.: p. 85, and Giddings 1951: Figure 64).

The seven fragments of blades not illustrated with this article are all of kinds similar to those described above and shown in Plate I. They comprise the following: one which has already been mentioned and is a part of a serrated point; four pieces that are the tips, or in one case possibly the base, of small bifacially worked blades; and two other pieces of bifacially worked blades, one of them probably a knife blade and the other showing incipient serrations.

Thirty-two microblades, or parts of microblades, were found on the site, i.e., in Areas A, B, and C. Of that total, 13 were found in Area A, 18 in Area B, and one in Area C. Only three of the 32 can be regarded as virtually whole artifacts; only one as complete. Eight of the pieces are shown in Plate I as Nos. 5 to 12 inclusive. The microblades, complete and broken, constitute a little more than 37 per cent of the total number of artifacts and worked pieces from Areas A, B, and C. If those pieces that can only be designated as worked chips, blanks, and debris are not included in the total, the percentage of microblades is increased to a little over 44. These percentages are given for what they are worth; considering the fragility of microblades and the number of broken specimens on the one hand, and the smallness of the total assemblage on the other, that worth cannot be very great.

There is nothing especially striking about the microblades, i.e., to enable them to be classed as particular types or to distinguish them in any individual way from microblades found at both Dorset and Arctic Small Tool sites. The rounded form of their bases, where they exist, is perhaps more in accord with microblades found in pre-Dorset assemblages, but the same form is not uncommon in Dorset assemblages from other sites (*see*, e.g., Collins 1956). Similar considerations apply to the profiles of the microblades. Their simple occurrence at the site is the most important thing about them. No cores were found. With one exception, all the microblades are of chert. That one exception should perhaps properly be called a lamellar flake rather than a microblade if, which seems to be a useful distinction, the group 'lamellar flake' can be regarded as a class of which the group 'microblade' is one member. The particular exception is made of a white quartzite and was struck from the outer surface of a core, and as a result its upper surface does not show a blade facet. On the same grounds, three (or four) more specimens should perhaps also be called lamellar flakes. There is little point in giving the lengths of the broken specimens: the widest one, shown in Plate I as No. 5, measures 1.13 cm, and the narrowest, actually the only wholly complete specimen and one of the lamellar flakes mentioned above, but not shown in the photograph, measures .41 cm in breadth and incidentally 2.25 cm in length. Ten of the specimens are between .51 cm and .60 cm in breadth; seven of them between .61 cm and .70 cm, five between .71 cm and .80 cm, and four between .41 cm and .50 cm. The thickest specimen, again a lamellar flake, is .32 cm thick, the thinnest .09 cm. Fourteen are between .10 cm and .15 cm in thickness, nine between .16 cm and .20 cm, and four between .21 cm and .25 cm. The most common cross-section is that of a flat under surface combined with three or four facets on the upper surface. A number of specimens, including those classed only as lamellar flakes, have a triangular or trianguloid cross-section, which circumstance no doubt has some relevance to the occurrence of the thickest specimen in that group. None of the specimens shows any deliberately made notches, but all except two show signs of wear on both longitudinal edges. Of the remaining two, one shows wear on one edge whilst the other has no signs of wear.

The 15 burins, 13 of which are complete, are an important part of the material. They represent about 18 per cent of the total number of artifacts and fragments from Areas A, B, and C, or a little more than 20 per cent of the total of identifiable artifacts. Four were found in Area A, nine were found in Area B, and two in Area C. All but one are made of chert, the exception being made of quartzite. Fourteen of the burins are shown in Plate II, as Nos. 1 to 13 inclusive and No. 16.

It is not proposed to classify the burins here in accordance with the terms of any of the numerous schemes that have, explicitly or implicitly, been put forward elsewhere. The typologies formulated by M. C. Burkitt (Burkitt 1955) and G. V. Noone (Noone 1934), whilst no doubt adequate for European material, do not appear to be able satisfactorily to accommodate North American examples. None of the typologies that have been used and expressed in the description of burins found in North America have yet gained general acceptance, and an apparent and confusing plethora of suggested types exists. No doubt many of those suggested types do have significance, but that significance has not yet been demonstrated in either generally cultural or specifically taxonomic terms. The distinction commonly made between corner burins and angle burins, for example, is often no more than the expression of the function of the number of spalls removed from the burin. The angle of the burin facet to the longitudinal axis of the implement necessarily becomes more oblique as more spalls are removed. In some cases a burin seems even to take on the characteristics of a different type according to its position when looked at or photographed, or according to what is held to be the longitudinal axis of the implement. Rather than pile Pelion on Ossa, add insult to injury, or rush in where wise men fear to tread, the burins described here are not placed in classes, and the only abstraction indulged is that of a simple statistical kind.

The thirteen complete burins range in length between 3.05 cm (No. 1 in Plate II) and 1.56 cm (No. 12). That shown as No. 2 is the broadest, being 2.41 cm in breadth, and that shown as No. 6 is the narrowest, with a breadth of only .92 cm. The thickest specimen is also No. 1, with a measurement of .70 cm; the thinnest ones are Nos. 10 and 11, both of which are .28 cm thick. There is a temptation to call the smallest specimens 'microburins.' The term is in conformity with the etymology of the English language; it is descriptively accurate and more succinct than its alternative, 'very small burins.' That it carries classificatory implications is no disadvantage, and that it might be held to pander to some persons' jargonistic impulses should be irrelevant. Unfortunately the term has acquired, by prior usage, a specialized meaning in European archaeology, whereby it denotes a burin-like implement made by a twisting fracture on a small blade, such tools being characteristic of certain Mesolithic assemblages. It is no defence of the European usage that the term carries with it contextual implications of a particular kind of microlithic industry. But although there can be none but a specious defence for that usage on etymological grounds, the term has received so general an acceptance in Europe that it has to be reserved for the implement, so far known only from European assemblages, that it was, inadequately, designed to describe. Consequently, but with only a reluctant admission of assent, it would be confusing to refer to burins such as that shown as No. 12 in Plate II as a microburin. It has no greater dignity than that of being a very small burin.

As it happens, the majority of the burins from Areas A, B, and C are rather larger than the one shown as No. 12. Three (including No. 12) are between 1.50 cm and 2.00 cm in length. Eight are between 2.01 cm and 2.50 cm long. One is 2.61 cm long, and one, already mentioned, measures 3.05 cm.

The number of spalls that have been struck off each burin varies, but all except one of the specimens show the scars of more than one burin blow. Four show the scars of three blows, and one the marks of four spalls having been removed. On four of the burins there are the marks of five blows, on three of them those of six blows, and two specimens have had eight spalls removed. On all the specimens, with the possible exception of that shown as No. 16, mentioned below, the spalls have been removed from one edge and at one end of the implement only. On those specimens where the bulbar scar is visible, i.e., the scar that represents the detachment of the implement as a whole from the original and parent nodule, the burin facet has been made at the bulbar end in only one case, that of the specimen shown as No. 11 in the accompanying photograph. In the five other cases where the distinction can be discerned, the burin facets have been made at the ends opposite to the bulbar scars.

All but one of the specimens show trimming on two or more edges, the one exception being the broken specimen shown as No. 16, but only one has any secondary trimming on the burin facet. That one example, No. 11, is trimmed on the under surface, not shown in the photograph, at the base of the burin facet. Seven of the specimens show trimming of what can conventionally be called the basal edges of the implements. There is no sign of grinding of any kind on any of the specimens, but one, No. 8 in the photograph, has a corner-notched base forming a tang.

The working on the body of the burins differs from one specimen to another. The majority of the implements show only rough working, other than the burin facets and edge trimming. Exceptions to the rule are the largest specimen, No. 1, and the smallest, No. 12, and also No. 3. The first has rough, horizontal chipping on its upper surface, with similar working on the under surface below the level of the base of the burin facet. The upper surface of No. 12, shown in the photograph, has little working, but on the under surface, and again below the level of the burin facet, it is neatly worked by horizontal chipping. Perhaps the most completely worked of all is No. 3, which has more or less horizontal chipping on the under surface and rough working on the upper surface. The specimen shown as No. 7 in the photograph is worked on its upper surface, principally by means of parallel longitudinal flaking that effectively thins the base, but is only crudely worked on its under surface. Some horizontal chipping appears on the upper surface of No. 5, but there is no working on the other face except for the edge trimming. The specimen with a most obliquely-angled burin facet, shown as No. 2, has rough and multi-directional working on its upper surface, but none, other than edge trimming, on its other face. It is possible that the sharply-angled projection which, as it is viewed in the photograph, is to the right of the upper part of the body, and which carries the burin facet, is a deliberately made form (*see* No. 2, Plate II). Similar examples have been found at Sarqaq and Igloolik, i.e., in pre-Dorset contexts (Meldgaard, J.: pers. comm.), in the Ivugivik Complex and in pre-Dorset assemblages found on Mansel Island (Taylor: MS.). An approach to the same shape is made in the case of the specimen shown as No. 7.

The broken specimen shown as No. 16 is a rather unusual form. The break occurred at what is now the right-hand part of the top edge, as shown in the photograph, the scars of at least six burin blows are visible on the left-hand side of the top edge. The part of the implement that carried the burin facet was the part that was broken off. The part that remains was presumably the shank and base of the implement and, on its upper surface, carries numerous narrow blade facets. The effect is not unlike that of a core. The under surface, representing the original detachment surface and with a remnant of the bulb of percussion at the lower end, is unworked. In its complete form the implement probably had the shape of a narrow triangle, an extension of its present shape, with the burin facet in the upper part of what appears as the left edge. It seems likely that the implement was hafted, the shank probably being sunk in the haft. On the right-hand edge there is the mark of what may be another burin blow, or it may represent a blade blow that was struck at an odd angle.

Five burin spalls, and two other pieces that may be spalls, were found. Two of the five spalls, including the one shown as No. 14 in Plate II, were reworked in the manner described by Giddings in his article on the burin spall artifact (Giddings 1956b). The one illustrated is reworked at the end opposite to that of the bulbar depression, the working edge—at the bottom end of the spall as it is shown in Plate II—being at right angles to the longitudinal axis. The other reworked specimen, not shown in the photograph, has been fashioned in a similar manner. The spall shown as No. 15 in Plate II has not been reworked.

A number of the burins can be matched closely with those found at other sites. No. 1, for example, is of a kind that is sometimes known as a Cape Denbigh burin, and is very similar to some of those illustrated in the report on the Iyatayet site (Giddings 1951) and to specimens found at the Engigstciak site, particularly those from the New Mountain horizon (MacNeish 1956 and 1959). Burins numbered 9, 12, and 13 can be compared, and appear to have an affinity, with some of the burins found at the Dismal-2 site (*see* Harp 1958, especially groups 11 and 12 in Figure 6). They are also matched, although the comparison cannot be supported by published reference, by burins found at Igloolik (Meldgaard, J.: pers. comm.), on Mansel Island, and at Ivugivik (Taylor, W. E.: pers. comm.). On the other hand, they do not match those of the Independence I assemblage, which are generally larger and more crude (*see* Knuth 1954).

The burins and burin spalls fit into a pre-Dorset and general Arctic Small Tool context. Comparisons between the other various and particular artifacts found at Cape Sparbo and those found at other sites have been made above, on individual grounds. The similarities noted in those comparisons can be summarized briefly, and the summary can serve as a congeries comparison, perhaps an unsophisticated method, but sufficient to the present purpose and within the limits of the methodological possibilities afforded by the assemblage. On the grounds of similarities in projectile points, the material from Areas A, B, and C of the Cape Sparbo site shows affinities with that of the Denbigh Flint Complex at Cape Denbigh, with that from Sarqaq horizons in West Greenland and with that from the Dismal-2 site on the Barren Grounds. All three of those sites are clearly of the Arctic Small Tool Tradition. The similarities between a point found at Cape Sparbo and points found in horizons that are rather late in the sequence at Engigstciak may be coincidental, but they may also have a relevance to the Arctic Small Tool Tradition in that material of that Tradition occurs in the middle horizons at Engigstciak.

On the grounds of similarities in blades other than projectile points and microblades, there appear to be affinities between the Cape Sparbo material and that from the four sites mentioned above, and also between the former, the North Knife River assemblage in northern Manitoba and some of the Ipiutak material. The first of the two last-named sites is of an Arctic Small Tool character, whilst an Arctic Small Tool element has long been recognized in the Ipiutak assemblage. The affinities of the burins have been remarked upon in the last paragraph, and the occurrence of microblades is in accord with the characters of all the sites mentioned above, as well as of the Independence I sites which are of the same Tradition, and with many Dorset sites and, of course, with sites of other Traditions excluded from consideration here by their other characteristics. Whilst the presence of microblades is neither a sufficient nor a necessary condition of an Arctic Small Tool identification, it is well in accord with its establishment.

A small percentage of the artifacts found at Cape Sparbo are perhaps of a Dorset character. In that connection it is relevant that there are Dorset sites known in southern Ellesmere Island (*see* Speck 1924), and that there is a mixed Thule-Dorset site only three miles from Cape Sparbo (Lethbridge 1939). One mixed Thule-Dorset collection from Devon Island is thought to have come from Maxwell Bay (files of the National Museum of Canada). It should also be mentioned, although no references can be made, that many of the artifacts from Areas A, B, and C—points, other blades, burins, and microblades—can be matched by material found in Arctic Small Tool (pre-Dorset) horizons at Igloolik (Meldgaard, J.: pers. comm.), and at various sites in Ungava and on Mansel Island (Taylor, W. E.: pers. comm.).

Thus the material from Areas A, B, and C at Cape Sparbo is principally pre-Dorset, Arctic Small Tool, with some that may be of a Dorset character. On the present evidence there does not seem to be a great deal of significance in the differential distribution of the artifactual material between the three designated areas. The possibly Dorset material occurs only in Areas B and C, but not even four swallows make a summer, and neither four, nor eighty-four, artifacts found in the course of a preliminary investigation are a basis for generalization. The situation may well be changed, however, when the site has been more fully excavated. The association of artifacts and faunal material beneath the surface in Area A is a point of potential significance, and another is the low altitude of the site as compared with pre-Dorset sites in, for example, North Greenland and also the Igloolik area. The presence of Thule, as well as pre-Dorset and perhaps Dorset, material on the site, in addition to being important in itself, offers the chance of information on the possible connections between pre-Dorset and Thule cultures that have recently been suggested by Meldgaard (Meldgaard 1960: p. 73). The possibility of a Dorset occupation is of both intrinsic and extrinsic importance, though in a wider perspective the geographical position of the site gives it a particular relevance to the development of cultures in the High Arctic. A more intensive excavation of the site is planned for the 1961 season.

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Plate I

Various artifacts (natural size)

PLATE I

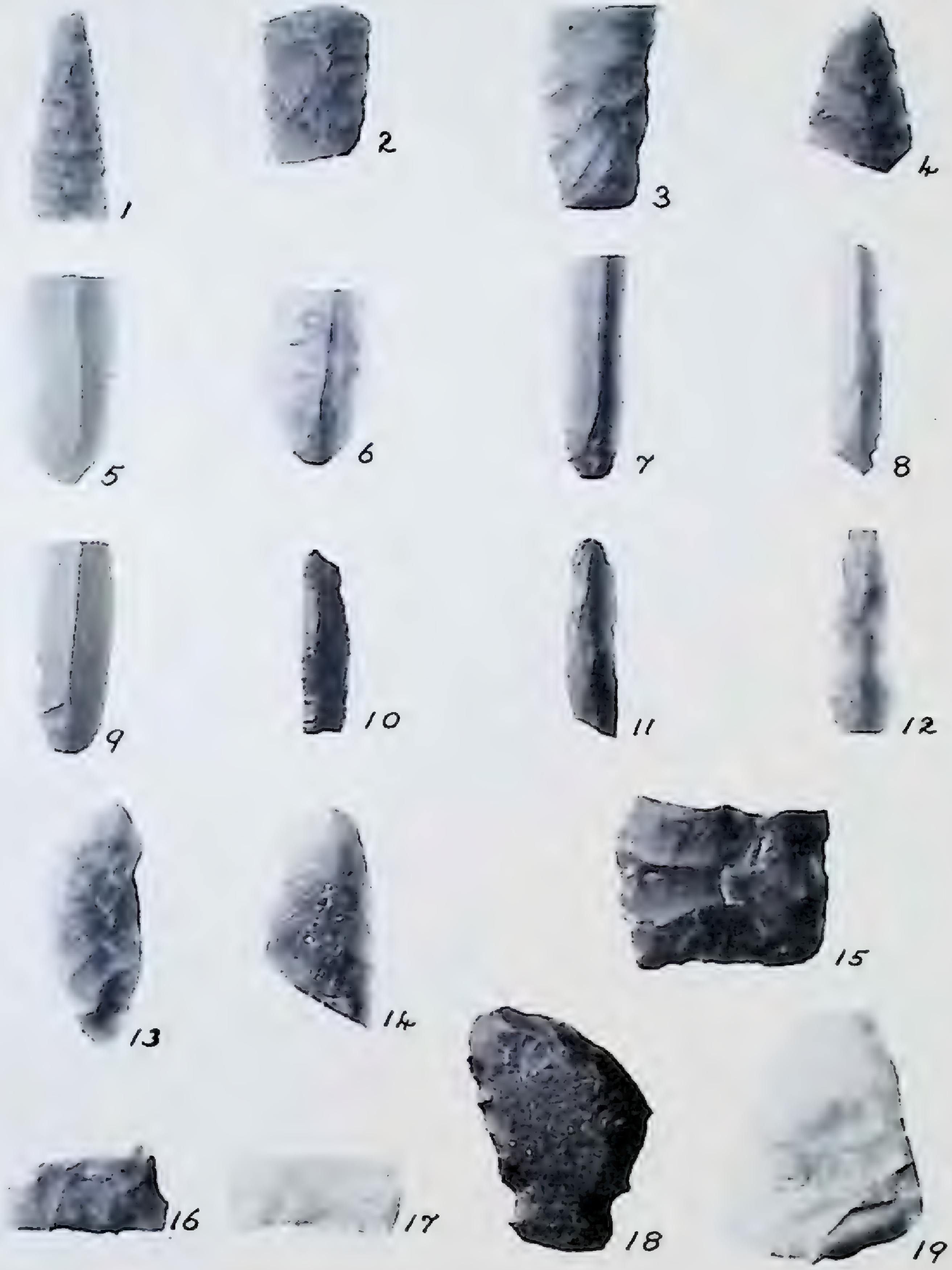
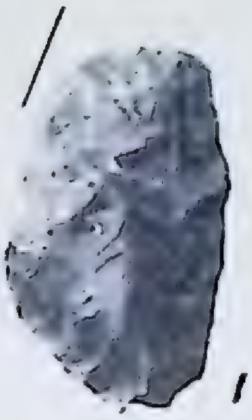


PLATE II

Various burins

Plate II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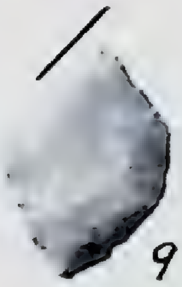
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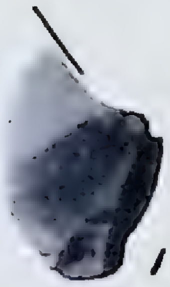
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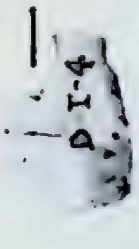

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PRE-DORSET AND DORSET SITES IN THE VICINITY OF LAKE HARBOUR, BAFFIN ISLAND, N.W.T.

A Preliminary Report

By Moreau S. Maxwell[1]

INTRODUCTION

In 1959 the National Museum of Canada received from Mr. J. F. Delaute, Regional Administrator for the Department of Northern Affairs and National Resources, a small but interesting assemblage of stone tools including burins, burin spalls, and "burin-like" artifacts. The collection came from Juet Island, close to the north shore of Hudson Strait, approximately 20 miles southeast of Lake Harbour. The Eskimo Davidee (E 7-54), who had collected the artifacts while cutting sod for a winter house, reported that the site was "layered," or stratified. Typologically, the material could have come from several time periods between early pre-Dorset and early Dorset, or from a single cultural assemblage transitional between what has, in the past, been called pre-Dorset and Dorset.

The assemblage was particularly significant in the light of the definition of early to middle pre-Dorset horizons made by Taylor (Taylor, n.d.) from sites at Ivugivik. A comparison of the Juet Island sample with material from Ivugivik indicated the possibility that the former could provide significant information for closing the gap between Taylor's Ivugivik sites and Collins' Proto-Dorset site on Southampton Island (Collins, 1956a, 1956b, 1957).

At the request of the National Museum of Canada, the author set out to investigate the site, and on August 9, 1960, with his son, Moreau S. Maxwell, Jr., as his assistant, he arrived at Juet Island (62° 36′ N., 69° 31′ W.).

The island is exposed to the full sweep of winds up the Hudson Strait, and, except for two six-hour periods, the weather was wet and stormy. On two occasions, five days apart, heavy rains and wind in excess of 80 miles per hour flattened our camp, soaking clothes and sleeping gear. The best days were foggy with a constant drizzle and temperatures ranging from 38°F. to 42°F. After thirteen days we left Juet Island and established field headquarters on a low neck of land at the southeast entrance to Lake Harbour in an area called Okalivialuk by the Eskimos, where we spent eight days in archaeological reconnaissance.

Five early sites were located on Juet Island and three early sites in Okalivialuk. Preliminary excavations were undertaken at three of the Juet Island sites and at two of the Okalivialuk sites. Typologically, and on the basis of elevation above the present high-tide mark, these five sites belong to five different time periods, all considered provisionally to be earlier than developed Dorset culture. The Annawalk Site (KeDr-1) at Okalivialuk, on the basis of typology and sea-level elevation, appears to be the earliest and may pre-date Taylor's Ivugivik sites. Next in time is the Killilugak Site (KeDr-3) at Okalivialuk, which appears to be roughly contemporaneous with Ivugivik, or slightly later; then the Davidee Site (KdDq-1) on Juet Island, which is stratified with three distinct layers; the Sandy Site (KdDq-2), also stratified with three cultural layers; and the Tiriak Site (KdDq-4), which more complete excavation may indicate lies within the Dorset continuum.

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DESCRIPTION OF SITES

Juet Island

This thinly vegetated, rocky island is shaped something like a short, thick question mark. Its main axis lies 17 degrees west of true north. The island, approximately two miles long and less than half a mile wide at its widest point, lies less than one-quarter mile off the shore of Baffin Island. The island is dominated by a hill approximately 700 feet high in its northeast corner. West of this hill is a low, flat neck of land between a cove to the south and open water to the north. Most of the centre of this gravelly, flat neck is covered by a shallow, brackish lake which is barely lapped by the highest tides of the month (35-foot tides). Northwesterly from the brackish pond the land rises to two knolls of approximately equal height on the northwest and southwest corners. In 1959 the Canadian Hydrographic Service established Monument 3581 on the northwestern knoll and determined the location to be 62° 36′ 42″ .388 N., 69° 31′ 37″ .726 W., and the elevation 71 feet above highest tide. Due south of this knoll is a flat plateau at an elevation of 46 feet with three large pools of fresh water. All the sites located on the island are on the northwestern corner, west of the brackish pool. Modern Eskimos have also used this section of the Island for camps.

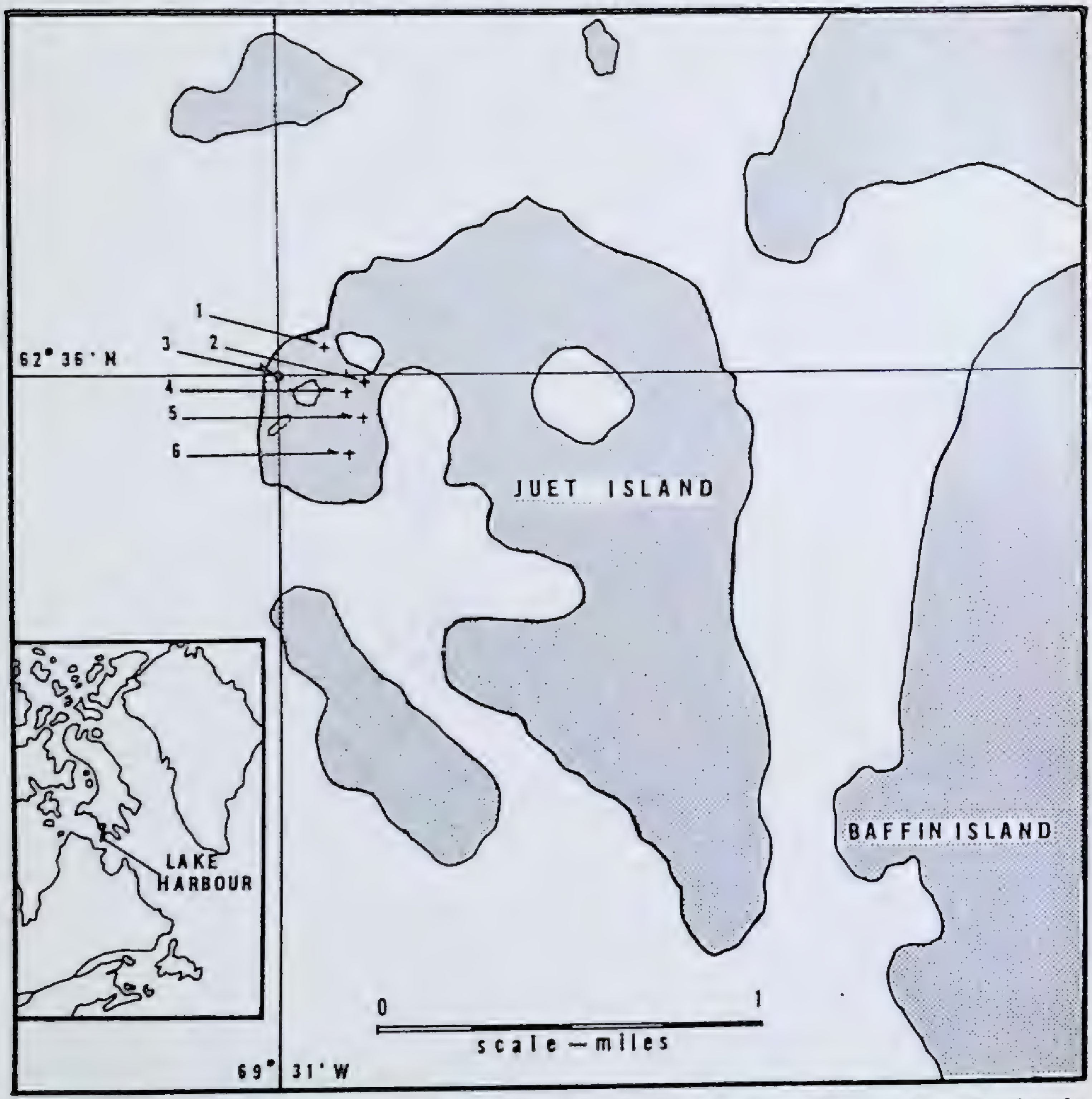

Figure 1. Location of sites on Juet Island. (1) Tiriak Site (KdDq-4), (2) Sandy Site (KdDq-2), (3) Canadian Hydrographic Service Monument 3581 (1959), (4) Davidee Site (KdDq-1), (5) Nipaluktok Site (KdDq-5), (6) Niggierk Site (KdDq-3). Inset map shows location of Lake Harbour, 20 miles northwestward.

In spite of heavy rainfall on the island, the vegetation is moderately sparse. There are a few pockets and small basins between rock outcrops where soil has accumulated. These spots have about 6 inches of gravelly humus and 2 to 3 inches of sod. Nowhere on the island is the humus more than 8 inches deep. The Precambrian bed-rock is a deeply weathered, orange, sandy schist, which is in the process of breaking down to small feldspar crystals and fine-grained angular gravel. Where this rock is mantled by a thin humus layer, there is no real transition zone between the fine, humus-laden gravel; the angular, clean, sterile gravel; and the crumbling bed-rock.

The modern Eskimos consider this island simply as an average seal-hunting area. During our stay we saw no sea mammals, only a few ducks, geese, and weasels.

Davidee Site (KdDq-1). The centre of this site lies 29 feet above the highest tide mark. The site covers a slightly rounded, moss-covered knoll between two north-south-running rock outcrops. Although no attempt was made during this season to test the periphery of the site, it appears to cover an oval area about 100 feet wide from east to west and 120 feet long from north to south. The ground slopes gently in all directions from the centre, with the greatest cultural concentration on the gently sloping south side, and little or no material on the steeper north slope.

The site has been extensively pitted, presumably by Eskimos taking sod chunks for winter houses. However, only six or eight of these pits appear to go down to bed-rock or base gravel. The largest pit is approximately 4 feet in diameter. There are a number of large rocks scattered over the surface of the site. These may once have served to hold down skin tents, but they have obviously been moved so many times that they no longer indicate the configuration of structures.

We laid out a trench, 5 feet wide and 20 feet long, running north and south, with the zero line approximately 10 feet north of what I estimated to be the beach line. This area of 100 square feet was stripped of sod, but because of the inclement weather we could excavate only the first five-foot square. All the artifacts came either from the surface of the site where they have been washed out of the sod chunks dislodged by recent Eskimos or from square O CL.

The sod is a mass of fine rootlets and moss, 2 to 3 inches thick. Beneath this is 6 to 8 inches of fine, angular, sandy gravel mixed with a small amount of humus. Vertical cuts demonstrated that the site was definitely stratified in three distinct layers separated by sterile gravel. The midden layers are black, greasy, rather rubbery, with many flecks of charcoal. Layer 1 varies in thickness from a fraction of an inch to 3 inches. Beneath this is a layer of clean, sterile, tan coloured sand and gravel from a fraction of an inch to 1½ inches thick. Layer 2, which is fairly uniformly 2 inches thick, is underlain by a layer of clean gravel one-half inch to 3 inches thick. Layer 3, which lies on top of the disintegrating bed-rock, is only one-half to 1 inch thick, but it is the blackest and most rubbery, and contains the most charcoal. Layers 1 and 2 are not always clearly separated, since the separating gravel was apparently laid down in thin lenses, rather than as a uniform layer. However, Layers 2 and 3 are always separated by a distinct layer of water-washed gravel. In each case the sterile gravel is water-laid and seems to be a beach deposit rather than having been washed down from above.

Six small (3 inches by 6 inches) flat rocks, heavily covered by charred organic material, were found isolated, or in clusters of two or three, in charcoal pockets in both Layers 2 and 3. These small "cooking rocks" are also characteristic of Sarqaq sites (Larsen and Meldgaard, 1958, p. 13).

A total of 197 artifacts were recovered from the site: 127 from the surface, 29 from Layer 1, 28 from Layer 2, and 13 from Layer 3. All of them are of stone. The bone material has rotted almost to a damp powder, but by carefully working away the surrounding gravel with a grapefruit knife we were able to determine the bone configuration. I am reasonably certain that none of the bones worked out in this manner were artifacts. The identified bones were seal, primarily humeri, and one caribou metapodial. A sufficient sample of charcoal, both local willow and coniferous (driftwood?), was recovered for isotopic dating, but dates are not yet available.

Niggierk Site (KdDq-3). This is a circular tent ring on a small, bare gravel flat between rock outcrops, at the same elevation as the Davidee Site and about 1,000 feet due north of it. The ring, 8 feet in diameter, is composed of moderately large, deeply weathered rocks with their bases covered by 4 inches of water-washed sand and gravel. There is a small cluster of rocks in the centre of the ring and what may be a sleeping platform remnant extending 2 feet east of the west wall. The tip of a polished "burin-like" tool from the present surface near the south wall is a later deposit and apparently is not coterminous with the tent ring.

We excavated only a small test trench along the interior of the south wall. Here, at a surface depth of 3 inches, is a slight trace of humus and rotted bone. The one artifact recovered from this layer, a non-distinctive end-scraper, tells us little about relative age.

There is a remnant of a second tent ring 40 feet north of this site at the same elevation, and two others about 10 feet higher and 60 to 100 feet to the northwest in a north-south cleft in the rocks.

Nipaluktok Site (KdDq-5). This site is approximately halfway between the Davidee and Niggierk sites and 5 feet below them (elevation 24 feet). It is a small, heavily turfed oval, approximately 30 feet by 45 feet, sloping slightly to the south and east. Very limited testing of the thin gravel layer under the heavy sod indicated that this was a sparse, single component site. A few quartz and chert flakes and two artifacts were recovered from this site.

Sandy Site (KdDq-2). This site, due east of the Davidee Site, rests in a narrow cleft in the rocks, 14 feet wide and 35 feet long, at an elevation of 18 feet above high tide. The north-south rock outcrops here form two walls about 2 feet high, and although the cleft provides no protection from north-south winds, it has apparently been used in recent times for a shelter. Modern Eskimos have removed much of the sod, but in only two small pits have they dug below the sod base. The site slopes gently to the south to what I suspect is a beach line, although this region is still untested.

There were very few artifacts on the surface, in spite of the extensive sod removal, and I suspect that most of the artifacts recovered by Davidee came from this site.

A base line was established running east and west between the southern ends of the two outcrops, and a vertical working face was maintained perpendicular to the long axis of the hollow. An area 10 feet by 5 feet was excavated to bed-rock, and all the artifacts were recovered from this area.

The site is definitely stratified with three well-marked cultural layers separated by water-washed gravel. The midden layers are not uniform in thickness, but generally Layer 1 is 1 inch to 3 inches thick, underlain by half an inch of clean gravel; Layer 2 is 2 inches thick, underlain by one-half inch to 3 inches of clean gravel, and Layer 3 is 2 inches thick and lies on disintegrating bed-rock at a surface depth of 6 to 8 inches. Layer 3 is the most pronounced, the greasiest and blackest, and contains the most charcoal (samples were recovered from this layer for dating). Also in Layer 3 were six of the small (approximately 3 inches by 6 inches), blackened sandstone slabs in pockets of charcoal. In all layers there was a concentration of charcoal, retouching chips, and artifacts against the slightly undercut southwest corner of the rock outcrop.

Bone material, although nearly decomposed, was in slightly better condition than in the Davidee Site. When carefully excavated, enough of the configuration remained to indicate that none of the fragments had been modified. All the recovered bones were from seals, except for one caribou metapodial. A total of 103 artifacts were recovered: 9 from the surface, 36 from Layer 1, 38 from Layer 2, and 20 from Layer 3.

Tiriak Site (KdDq-4). This site, located late in our stay at Juet, was tested with a trench only 4 feet long, 5 inches wide, and 4 inches deep. The site, in a small, level hollow between two rock outcrops, lies at an elevation of 12 feet above high tide. Since there are much better flat gravel camp-sites close to the Tiriak Site, but 5 to 7 feet lower in elevation, we assume they were under water when the site was occupied.

The site is apparently 25 feet wide from east to west and 60 to 100 feet long from north to south. There are a few places where Eskimos have stripped sod and several large rocks litter the site surface; but no structures are apparent. From our limited testing, this site is a single component with a very black, greasy midden layer, 4 inches thick. The bone from this site is sufficiently well preserved to recover whole pieces. All the bones recovered were unmodified seal bones. Only 14 artifacts were found in this site, three from the surface and 11 from the sub-surface.

Okalivialuk

This is a rock ridge, approximately 150 feet high, running north and south, connected by a low, narrow neck of land to Baffin Island, at the southeast approach to Lake Harbour. The low neck of land, which rises in the centre to an elevation of 60 feet above the highest tide, is marshy and is lushly vegetated with grass, marsh cotton, and moss. There is a deep cove to the south, and all the early sites located face this cove, whether on the highest part of the narrow neck of land or on the slope of the rocky north-south ridge.

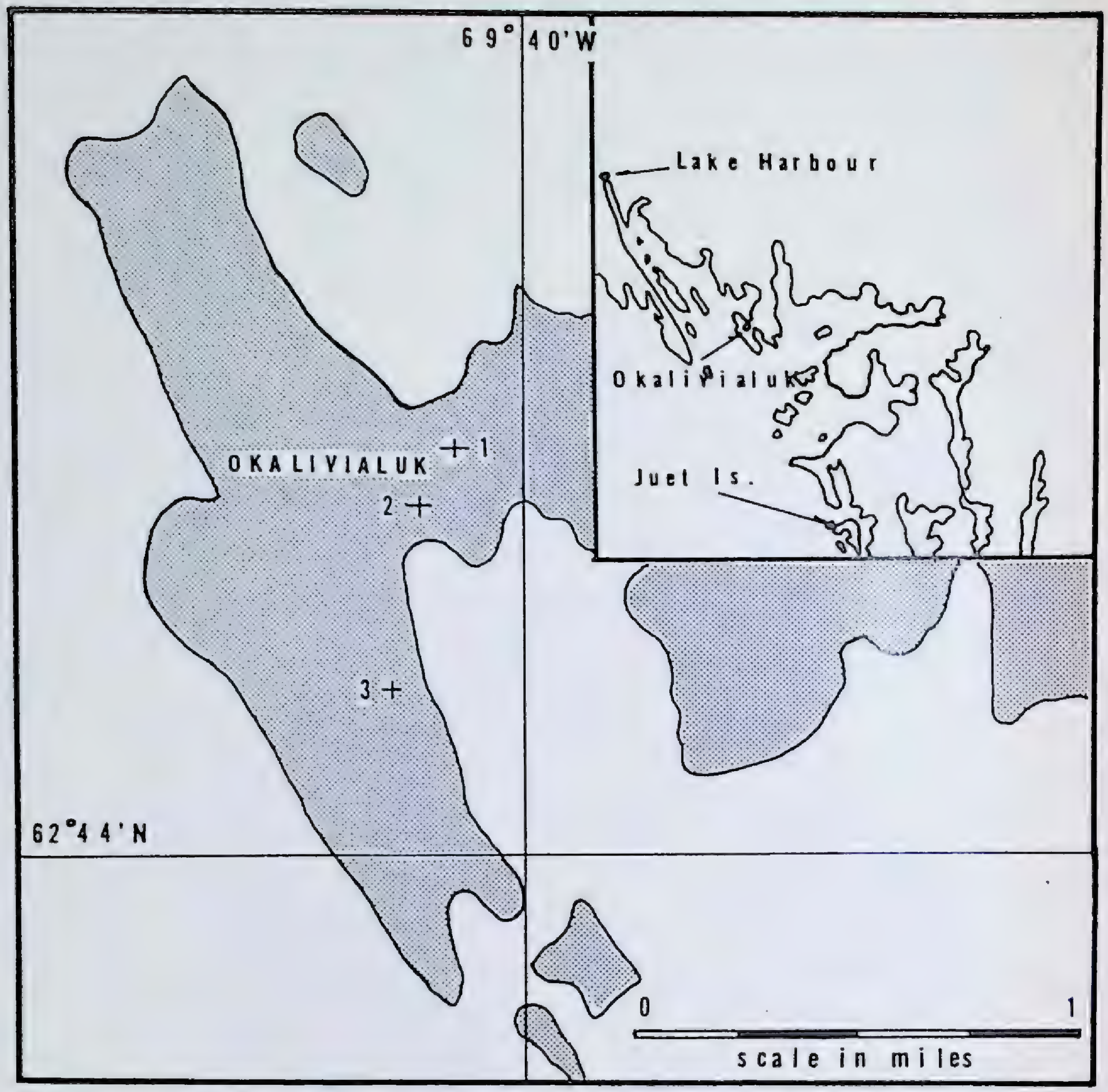

FIGURE 2. Location of sites on Okalivialuk: (1) Site (KeDr-2), (2) Killalugak Site KeDr-3), (3) Annawalk Site (KeDr-1). Inset map shows relative locations of Lake Harbour, Okalivialuk, and Juet Island.

Annawalk Site (KeDr-1). This site, 60 feet above high tide, rests in a small, level-floored, thickly-sodded valley between north-south rock outcrops on the east slope of the small, rocky peninsula. The site, which is approximately 40 feet wide from east to west and 80 feet long, is protected from Hudson Strait to the west but exposed to the southeasterly winds. Against the east rock wall, a catchment basin has washed out the humus, destroying approximately one-third of the site.

We established a zero stake at the northwest corner of this solution pond and staked out a 5-foot-wide trench east and west, perpendicular to the long axis of the valley. This trench, 5 feet wide and 20 feet long, was completely excavated down to the disintegrating bed-rock.

The cultural horizon, 4 to 10 inches thick, contains very little humus and no trace of bone or charcoal. Since there were no indications of stratigraphy, the site was excavated in two arbitrary 3-inch levels.

The recovered artifacts are treated below, but it is significant to note here the following three points: (1) reject flakes from this site, almost all of fawn-coloured chert, are spalls from chert pebbles with prepared striking platforms, whereas those from the Juet Island sites all appear to be microblades and blades struck from polyhedral cores; (2) there is a much higher percentage of reject chert material at this site than on the Juet Island sites where practically every flake of chert, no matter how small, was utilized; (3) some spall flakes from this site were modified only by a slight retouching along one or more edges, or by burin blows at the corners, whereas flakes and blades from the Juet Island sites were more completely shaped to conform to a preconceived pattern.

In all, 100 artifacts were recovered from the site; 22 from the surface, 74 from Level 1, and 4 from Level 2.

Site KeDr-2. This thinly occupied camp-site, at an elevation of 59 feet, rests on the height of land in the centre of the low neck. Limited testing under the thick moss sod yielded only two burins and a few reject flakes. It is significant that solution ponds at this elevation contained reject flakes and at least one burin, whereas pond basins at elevations 8 feet or more below this elevation do not. Presumably this was a very small, round island when the water stood 57 feet above its present elevation.

Killalugak Site (KeDr-3). This site, at an elevation of 33 feet, occupies a small, rock-rimmed hollow on the western part of the low land neck. The hollow, about 60 feet wide east to west and 100 feet long, is very thickly sodded. The ground slopes to the south to what appears to be a clean sand and gravel beach overlaid by 6 inches of very tough sod.

We located the site on our last day at Okalivialuk and were able to spend only five hours in stripping sod and testing small areas. From our limited investigation I feel that this may be the most intensively occupied site in the Lake Harbour region.

Although the site is not stratified and the cultural layer appears to be only 4 to 6 inches thick, it contains an unusual quantity of chips. In one locality, two small rocks, side by side beneath the sod, were covered by a mass of chert and quartz chips and ten fragmentary artifacts in a small pile.

A total of 63 artifacts were recovered from the site: 54 from Level 1, immediately beneath the sod to a surface depth of 3 inches; and 9 from Level 2, at a surface depth of 3 to 6 inches.

DESCRIPTION OF ARTIFACTS BY SITES

Annawalk Site (KeDr-1)

Burins. Forty-two burins were recovered from the site. Six of these were formed on bifacially-worked blades. (Throughout this description artifacts which appear to have been fabricated from a roughly parallel-sided lamellar flake, driven from a prepared core, or from a pebble with a prepared striking platform, will be referred to as "blades," not "flakes" or "spalls," which are more or less uncontrolled flakes driven by percussion from flint pebbles which have no apparent striking platforms.) These burins all have a negative bulb of percussion, formed when the burin spall was driven off, and traces of a striking platform at the point of impact for the burin spall. Under magnification, all show wear at the working edge (Plate I, fig. E, and Plate II, fig. A, E, H, and M). Three are multiburins on bifacially-worked blades with two to three burin spall scars on the same number of corners; three show multiple burin spall scars up to a total of eight.

Thirty-six of the 42 burins are unifacially worked. Eleven are on unifacially-worked blades (Plate I, fig. A–D; Plate II, fig. B, D, I, J, and N). Nine are single burins, and of these nine, seven have multiple spall scars up to a total of five, and eight have at least two retouched edges. Three of the burins on unifacially-worked blades were hafted; two have basal thinning (Plate I, fig. C, and Plate II, fig. H), and one has basal thinning and a slight, rounded notch on the spall side with bevelling at the burin edge (Plate I, fig. B). There are three multiburins on unifacially-worked blades; one multiburin has burin scars on all four corners. Eighteen burins are on unifacially-worked flakes or spalls (Plate II, fig. K, L, O, P, R, and S). Six of these flake burins have burin scars on two corners. Of the twelve single burins, four have from two to eight multiple burin scars at one location. Seven flake artifacts are burins with cutting or scraping edges opposite the burin spall scar. Five of these artifacts have scraper edges opposite the burin spall scar; one large flake has a retouched cutting edge terminating at one corner in a burin (Plate III, fig. B); one retouched flake appears to have been made solely for the production of a long burin spall (Plate II, fig. L). The burin edge of this artifact shows no dulling through use.

Burin blank. One artifact is of a type which Taylor (Taylor, n.d.) has called a "burin blank." This is a bifacially-worked blade with a deep corner notch, produced by a steep retouch, and with two retouched, bevelled edges. According to Taylor, these artifacts have been prepared for striking off the preliminary spall but have not yet been used as burins (Plate II, fig. C). The shape of this artifact resembles a concave side scraper, but under magnification it displays none of the minute use scars of a scraper.

Burin spalls. Twenty-five burin spalls were recovered. Fifteen of these are primary spalls, triangular in cross-section (Plate III, fig. G, L, M, and O). Ten of the 15 spalls are retouched at the distal ends (the end away from the bulb of percussion) where tiny pressure flakes have produced a scraping edge. Seven show slight grinding at the proximal end, which has probably been caused by use of the basic artifact as a graver before the burin spall was struck off.

Ten of the burin spalls are secondary ones (Plate III, fig. N, P to S) and rectangular in cross-section. Four of these secondary spalls have been retouched at the distal ends; five show a use polish at the proximal ends.

Microblades. At this site no true microblades in the sense of thin, parallel-sided lamellar flakes, driven by a controlled pressure or percussion flaking from a prepared polyhedral core, have been found. The appearance of all blade tools from the site suggests that the technique of core and lamellar blade fabrication is a new device to the inhabitants, and they have not yet mastered the technique. Of the nine small lamellar flakes driven from a prepared striking platform, two are of chert, both retouched on the edges (Plate II, fig. O), and seven are of quartz crystal (Plate III, fig. H, I, K), two of them retouched along the edges.

Retouched flakes. Nineteen flakes with one or more retouched edges were recovered. Three of these are of quartz crystal, two with cutting edges and one with a single-bevelled scraping edge. Sixteen are of chert—nine with cutting edges, four with scraping edges, and three with both cutting and scraping edges.

Cores. One exhausted quartz crystal core was recovered.

End blades. Only two fragments of end blades were recovered. One (Plate III, fig. E) appears to be a basal fragment of a straight-based, slightly side-notched end blade or projectile point, broken with a hinge fracture. One corner of the hinge fracture has a small burin scar which, under magnification, shows wear as of a graver. The other (Plate III, fig. F) is a unifacially-worked medial fragment of a blade tool.

Perforators. One bifacially-worked medial fragment of a perforator was recovered (Plate III, fig. J).

In addition to the artifacts, we found in the bottom level of the site what appears to be a lump of charred seal fat mixed with sand. This, I hope, will provide a Carbon-14 date for the occupation.

Four points should be stressed with regard to the assemblage from this site: (1) that there are relatively few artifact types; most of the tools found are related to the burin industry; (2) that there is a higher percentage of unused or rejected flakes than in the Juet Island sites and that these are usually spalls driven from oval chert pebbles approximately 1½ inches long; (3) that, although striking platforms were prepared on the pebble cores, the technique of driving thin, parallel-sided microblades from polyhedral cores does not seem to have been perfected in this assemblage; (4) that there does not appear to have been any deliberate grinding and polishing of stone tools in the Annawalk assemblage.

Killalugak Site (KeDr-3)

Burins. Seven burins were recovered (Plate IV, fig. C and E). Two are bifacially-worked blades; one (Plate IV, fig. E) is a multiburin with burin scars on three corners; the second appears to be a re-worked, broken projectile point, with graving facets on both edges of the hinge fracture and three burin spall scars at the upper left margin. Five of the burins are unifacially-worked flakes; two of these are multiburins.

Burin-like tools. One small, double-tapered, polished slate artifact with one straight edge, one convex edge, and an obliquely-angled end (Plate I, fig. R) appears to have been made for a function similar to that of the Dorset burin-like tools.

Burin spalls. Five burin spalls were recovered. Three of these (Plate IV, figs. N and P) are primary spalls, triangular in cross-section, with no retouching at the distal end. Two with rectangular cross-sections are secondary spalls, one of which has been highly polished on three facets (Plate IV, fig. O).

Microblades. Thirty-three microblades were recovered (Plate IV, fig. H to M and R to U). Seventeen of these are of quartz crystal, seven of which have been retouched along the edges. Four are side-notched (Plate IV, fig. R), presumably for hafting. Sixteen microblades are of chert; none are retouched, but eight have use scars along the edges, and two are bifacially-worked at the striking platform end.

Bifacially-worked end blade and knife fragments. Three bifacially-worked blade tool fragments, all of chert, were recovered. One asymmetrical fragment is presumably a knife (Plate IV, fig. A); one asymmetrical base fragment with straight, slightly expanded base and shallow side notches appears to be an end blade or projectile point (Plate IV, fig. B); the third (Plate IV, fig. Q) is the tip of an end blade.

Scrapers. There are three scrapers from this site. Two are quartz crystal end scrapers, crudely made, bifacially-chipped, roughly rectangular in shape, and steeply bevelled at the scraping edge. The third is a unifacially-chipped side scraper with a straight scraping edge.

Cores. One quartz crystal exhausted core and one broken chert core (Plate IV, fig. G) were recovered. The quartz crystal core is polyhedral by virtue of its original crystalline shape; the chert core fragment is too small to allow reconstruction of its original shape.

Retouched flakes. Nine flakes with retouched edges were found. Six are chert flakes; three are quartz crystal. Three of the chert flakes have plano-convex scraping edges; the remaining flakes have cutting edges.

Although the sample from this site is small, it is significant to note that the microblades are skilfully made and dominate the assemblage. The technique of manufacturing these artifacts involves a carefully controlled lamellar flaking of prepared polyhedral cores. On the other hand, little attention has been given to the shaping of burins. Most of them are incidental flakes or reworked tool fragments.

Davidee Site (KdDq-1)

Burins. Ten burins were recovered, all of chert. Three were apparently hafted; bifacially-worked and thinned at the base, they have shallow, rounded side-notches. These three have some polishing on one or both faces, varying from slight, local polishing near the working edge to 25 per cent of the total area (Plate I, fig. F, G, and Plate V, fig. G). The three hafted burins have narrow striking platforms, and each has two to five burin scars at one corner. Seven of the burins (Plate V, fig. N through Q) are unifacially-worked flakes; of them, two are multiburins and one (Plate V, fig. Q) is a combination scaled burin and scraper.

Burin-like tools. Eight of these distinctive artifacts were recovered. Six (Plate I, fig. P, S, U, and Plate V, fig. Y through AA) are similar in most of their discrete attributes. They are made of a tough, fine-grained chert, bifacially-worked and polished over most of their surfaces. The "graving" edge is relatively broad, flat, and highly polished. The distal edge (opposite to the base) is steeply bevelled from both faces and highly polished; the proximal edge is usually left rough and thick. The edge opposite the working face is thin, double-bevelled, chipped, and occasionally also ground and polished. The edge with the working face has a small, round notch near the base; more rarely there is another notch on the opposite edge. The artifact was apparently hafted to the side of a grooved bone handle. These burin-like tools are characteristically found on Dorset sites in the eastern Arctic. One small, polished, triangular artifact (Plate I, fig. T) with a polished "graving" facet on the upper right margin is apparently related to these burin-like artifacts, as is a crudely worked quartzite flake (Plate I, fig. Q) with a broad, polished, facet.

Burin spalls. Thirteen burin spalls were recovered (Plate V, fig. T to X). Six of these are primary spalls, two with retouching on the distal ends; seven are secondary spalls, one with retouching on the distal end and four with residual grinding on the proximal ends.

Microblades. The sample from the Davidee Site includes 83 microblades (Plate V, fig. DD to MM). Sixteen are made of chert, three of which are retouched along the edges; four have no retouching but have use scars along the edges, and one fragment is completely polished on its ventral and dorsal surfaces. Sixty-seven microblades are of quartz crystal; 21 are side-notched at the striking platform end (Plate V, fig. JJ); 16 are retouched along the edges, and 10 without retouch have use scars along the edges.

End blades, projectile points, and knives. Twenty-two bifacially-worked blade cutting tools and fragments were recovered from the site including six of chert, 11 of quartz crystal, amorphous quartz, and quartzite, and three of slate. Of these 22 artifacts, 12 are tips or medial fragments of questionable function. Seven complete artifacts and basal fragments (two of chert, four of quartz, and one of slate) appear to be harpoon end blades. These are primarily triangular with straight or slightly concave bases (Plate V, fig. E, H, J). One chert end blade is ovate with a slightly convex base (Plate V, fig. B). One slate end blade or projectile point fragment has a straight base with a slight shoulder on one edge (Plate V, fig. C). One chipped and ground slate end blade or projectile point (Plate V, fig. K) has a straight base, small side notches, and edges sharpened by grinding. Two side-notched artifacts (Plate V, fig. D and F), one of chert and one of amorphous quartz, appear to be asymmetrical, transverse-edged knives.

Perforators. There are two quartz crystal perforators in the Davidee sample. One (Plate V, fig. BB) has side notches and a slightly expanded base.

Retouched flakes. The sample includes 39 flakes with one or more edges retouched: 22 of chert, 15 of quartz, and 2 of slate. Twenty-six of these flakes were used for cutting, 11 for scraping. One slate flake (Plate V, fig. A) has all its sides ground to sharp, cutting edges.

Scrapers. Ten scrapers were recovered, two of chert and eight of quartz crystal. The two chert scrapers (Plate V, fig. R) and four of the quartz scrapers (Plate V, fig. M and S) are end scrapers. The chert end scrapers are truncated triangles with steep bevels at the working edges. The quartz crystal end scrapers are very small, sub-triangular to roughly rectangular, and have steep bevelling. Two small quartz crystal side scrapers have concave edges; the other two have convex edges.

Cores. There are nine cores in the sample, all of quartz crystals exhausted in producing microblades.

Bowl or lamp fragment. This fragment of a small, oval steatite lamp or bowl came from Layer 1.

Certain distinctive characteristics of the sample from the Davidee Site should be noted. First, although the samples from the three distinct layers are at present too small to demonstrate definite trends, there are significantly greater numbers of polished tools and burin-like artifacts in the top layer. Secondly, there are few reject flakes in the sample that have not been retouched or made to serve some function. Thirdly, although 14 per cent of the artifacts are related to the burin industry (burins and burin spalls), most of them are of types considered characteristic of Dorset assemblages. Such Dorset traits are as follows: side-notched asymmetric knives; burin-like artifacts; small, triangular, slightly concave-based end blades; polished slate end blades; the oval stone lamp; chert and quartz crystal microblades. One artifact type—the basal-thinned, side-notched, slightly polished burin—is a possible transitional form between earlier burin types and the burin-like tool. It should be noted that although the burin-like tool appears similar in shape to the burin and may have developed from it, the two artifact types, however, may have been used for different functions. While the burin is designed for cutting and abrading, the highly polished working face of the burin-like artifact is flat and appears to have been designed for a creasing or polishing function.

Sandy Site (KdDq-2)

Burins. A total of five burins were located in this site (Plate VI, fig. A to C; Plate I, fig. K). One of these (Plate I, fig. K) is bifacially-worked, with thinning chips at the base, slightly side-notched, bevelled to a sharp edge opposite the base, polished over 25 per cent of its surface, and with a prominent burin spall scar at its upper left margin. The remaining four burins are unifacially-worked flakes. One of these four (Plate VI, fig. A) has a slight side notch on one edge. These flake burins all have traces of thin striking platforms at their distal ends, and the spall scars have small negative bulbs of percussion.

Burin-like tools. Seven burin-like tools were recovered (Plate I, fig. L to O and Plate VI, fig. D, H, and I). This is a characteristic artifact mentioned elsewhere in most reports on Dorset sites and described on page 31. These artifacts are usually polished on all surfaces except the bases.

Burin spalls. There were three burin spalls located in the excavated area (Plate VI, fig. J and K). Two are primary spalls, and one is a secondary one, polished on three facets.

Microblades. Thirty-seven of these were recovered (Plate VI, fig. E, F, and L to U). Of these, eight are of chert, and 29 are of quartz crystal. Of the chert microblades, one has side notches at the bulb end, and three have retouching along the edges. Ten of the quartz microblades have side notches, and nine are retouched along the edges.

End blades and side blades, and projectile points. Nineteen end and side blades and fragments were recovered. Eleven of these bifacially-chipped artifacts (eight of quartz crystal, one of chert, and two of slate) are presumably harpoon end blades. Four of quartz crystal are serrated tips or medial segments and are not illustrative of shape. The remaining four quartz crystal specimens and the chert end blade are triangular with serrated edges. Three quartz crystal triangular end blades have straight bases (Plate VII, fig. F, K, and L); one (Plate VII, fig. J) has a slightly concave base, and the chert triangular end blade has a deeply concave base. The slate end blades include a medial fragment (Plate VII, fig. O) and a rounded tip fragment (Plate VII, fig. Q). There are two chert, bifacially-worked, asymmetrical artifacts. One (Plate VII, fig. C) has shallow side notches, a convex base, and a transverse cutting edge and is presumably an asymmetric knife. The other (Plate VII, fig. S) is small, long, and narrow, with small side notches, one straight edge, one convex edge, and a rounded tip. This artifact was apparently hafted as a side blade. Six of the artifacts are presumably projectile points. Two of these are non-distinctive, long, narrow, serrated tips. One (Plate VII, fig. A) is straight-based with slight side notches, serrated sides, and a ground edge at the base. One (Plate VII, fig. V) is straight-based with shallow, rounded side notches and no serrations. One (Plate VII, fig. B) is a unifacially-worked flake with slightly convex base; another (Plate VII, fig. P) is small, diamond-shaped in cross-section, with prominent medial ridges, a concave base, rounded side notches, and fine serrations along the edges.

Scrapers. Thirteen of these were recovered from the site. A distinction is made here between scrapers that have been deliberately shaped to some traditional pattern and retouched flakes that have one or more scraping edges. Two of these scrapers are of chert; eleven are made of quartz crystal. One chert scraper (Plate VII, fig. D) appears to be a hafted side scraper. The other chert scraper (Plate VII, fig. H) is a unifacially-worked, trapezoidal end scraper, triangular in lateral cross-section and steeply plano-convex in longitudinal section. Four of the quartz scrapers (Plate VII, fig. M, T, and W), which have flared edges, were apparently hafted. The seven remaining end scrapers (Plate VII, fig. E, I, N, U, and X), which are very small, sub-triangular to roughly rectangular, and steeply plano-convex, are made of quartz crystal; two of these (Plate VII, fig. N) appear to have been hafted.

Hammer. One lump of amorphous quartz which is battered along one edge has been used, apparently, as a hammer.

Cores. The site contained one fragmentary chert pebble core (Plate VI, fig. G) and four quartz crystal cores.

Bowl or lamp fragment. This is a fragment of a small, oval sandstone lamp or bowl which came from layer 2.

Retouched flakes. Twelve were recovered from the site. Nine of these have cutting edges, four have scraping edges, and one has both scraping and cutting edges. One flake scraper (Plate VII, fig. Y) has a concave working edge.

Although there are three distinct cultural layers at this site, we do not yet have sufficient samples from each layer to make meaningful statements about cultural change internal to the site. However, there are some distinct typological differences between this assemblage and the one from the

Davidee Site: additional Dorset traits appear for the first time (in our seriated group of sites) in the Sandy Site assemblage. These additional Dorset traits are the side-notched, serrated-edged projectile points (from the bottom layer) which show possible Newfoundland affinities; the flared-edged end scrapers, the sandstone lamp, and the quartz crystal end blades with serrated edges and concave bases. Earlier traits such as the true burin and burin spall are not yet lost from this continuum.

Tiriak Site (KdDq-4)

This site produced only 14 artifacts. Although this assemblage is too small for a significant frequency distribution analysis, it is worth noting that it appears to follow certain earlier trends in artifact frequencies (*See* Table II).

End blades. One triangular, serrated-edged, quartz crystal end blade was recovered from the site.

Microblades. Four were recovered, two of chert, including one with retouched edges and two of quartz crystal.

Scrapers. There are three quartz crystal end scrapers. These, roughly rectangular in plan view and steeply plano-convex in cross-section, are larger than the rectangular quartz crystal scrapers of the Davidee and Sandy Sites.

Hammer-chopper. One sharpened, amorphous quartz flake was found. This artifact had a convex edge which had been battered and blunted by use in chopping.

Perforator. One perforator was recovered from the site. This is an unhafted flake of quartz crystal, bifacially-worked to a sharpened end.

Adze. One rubbed slate adze, crudely rectangular and plano-convex in cross-section, was found in the site.

Retouched flakes. Three retouched flakes complete the assemblage from this site. Two of these are made of quartz crystal; one is of chert. All three have cutting edges, and two have scraping edges as well.

EVIDENCE OF CULTURAL CHANGE BETWEEN SITES IN THE LAKE HARBOUR VICINITY

If five of the assemblages located in the vicinity of Lake Harbour are arranged in sequence in accordance with site elevations above sea-level, on the assumption that the sites at highest elevations are oldest, certain artifact trends are readily apparent. These trends can best be seen when key artifacts (those present in greatest numbers) are expressed in terms of percentage frequencies (cf., Tables 1 and 2). Admittedly these percentage frequencies are less convincing where the artifact samples are small. Percentage frequencies from the Tiriak Site (KdDq-4) are of little value in this comparison since the sample (14 artifacts) is far from a random one for the site.

Although Arctic archaeologists have learned to suspect too rigorous a correlation between the age of assemblage and sea-level elevation, it is true that, statistically, such correlation does exist. The final proof of *specific* correlation rests on an evaluation of geomorphological conditions at each site, an evaluation not yet made for the sites under consideration. Our preliminary excavations *suggest* that these five sites, and three related sites, were located on sea-washed beaches. Further field work should prove or disprove this contention. However, we feel that it is valid to assume, at this point, that the sites can be ranked serially with the oldest site, the one highest above sea-level. Tables 1 and 2 demonstrate effectively that there is such a seriation; there are also comparable seriations in types of raw materials, in the relative frequencies of polished artifacts, in the number of types of artifacts used (Table 2—Others), and in the relative frequencies of each of six key artifact types. Only two types of artifacts fail to conform to a progression or regression curve. Microblades make a notable surge in popularity and then wane, and retouched flakes fluctuate in percentage frequencies.

This apparent progression or regression of the relative importance of certain tool traditions in site assemblages lends itself to some interesting statistical treatment. Briefly, the relatively small sample assemblages in hand have been inspected by a method described by Spaulding (Spaulding, 1961, p. 81) for determining indexes of likeness or unlikeness. When these indexes are arranged in a matrix, we find an increase toward the diagonal on both vertical axis and horizontal axis, suggesting a probable chronological seriation. It may only be coincidence that when the index of dissimilarity between assemblages is divided by the elevation which separates them (a suggestion of the rate of change between assemblages) we find a fairly uniform rate between all assemblages, except the rate of change between the Killalugak Site (KeDr-3) and the Davidee Site (KdDq-1). This suggests either a more rapid rate of cultural change (the introduction of new elements) or a decrease in the rate of sea subsidence between these two sites. The statistics involved have not been treated in detail here, because we have a frank suspicion of them at this preliminary stage of the investigation of early sites in the Lake Harbour vicinity.

TABLE 1. *Percentage frequencies of raw materials and of ground and polished artifacts from five sites in the vicinity of Lake Harbour*

	Site KeDr-1	Site KeDr-3	Site KdDq-1	Site KdDq-2	Site KdDq-4
Sea-level elevation	59′ 3″	33′ 6″	29′ 3″	17′ 9″	12′ 2″
Size of sample	100	63	197	103	14
	%	%	%	%	%
ARTIFACT MATERIALS					
Chert	88	62	38	44	21
Quartz	12	36.5	58.5	53	72
Others (slate, steatite, sandstone)	0	1.5	3.5	3	7
	%	%	%	%	%
GROUND AND POLISHED TOOLS	0	3	10	11	7

TABLE 2. *Percentage frequencies of key artifacts from five sites in the vicinity of Lake Harbour*

	Site KeDr-1	Site KeDr-3	Site KdDq-1[1]	Site KdDq-2[1]	Site KdDq-4
ARTIFACTS					
Burins	42	11	5	5	0
Burin spalls	25	8	7	3	0
Burin-like tools	0	1.5	4	6	0
Microblades	9	52.5	42	36	29
End scrapers	0	5	5	13	22
End blades and knives	2	5	11	19	7
Retouched flakes	19	14	20	12	21
Others	3	3	6	7	21

[1] After the preparation of this material, two samples of artifacts from Juet Island, mislaid in transit, were made available for analysis. These include a sample of 147 artifacts collected on Site KdDq-1 by Dr. Graham Cooch and a sample of 77 artifacts collected by Davidee on Site KdDq-2. The combined sample from the Davidee Site (KdDq-1) provides the same frequencies for burin spalls, burin-like tools, and end scrapers; 7 per cent for burins, 40 per cent for microblades, and 13 per cent for end blades and knives. The combined sample of 180 for the Sandy Site (KdDq-2) provides the following percentage frequencies: burins, 6 per cent; burin spalls, 2 per cent; burin-like tools, 6 per cent; microblades, 33 per cent; end scrapers, 14 per cent; end blades and knives, 22 per cent.

This statistical treatment, in its least objectionable form, demonstrates what is apparent from a cursory inspection of typology and of type quantities—that there is an apparent cultural continuum between the oldest and the most recent sites treated here. At the recent end of this continuum, we find that the majority of artifacts are of types which are well documented from Dorset sites. At the other end of this particular continuum is the Annawalk assemblage, with artifact types and frequencies, which has elsewhere been called pre-Dorset. However, the apparent regularity of increase or decrease of specific artifact types, degree of polishing, and choice of raw materials in the seriated Lake Harbour samples appears to make the actual separation between "pre-Dorset" and "Dorset" an academic one. In the Lake Harbour vicinity, pre-Dorset does not appear to be a separate cultural entity (or "Sarqaq"), as has been suggested by Meldgaard (Meldgaard, 1960), Larsen (Larsen and Meldgaard, 1958), and Mathiassen (Mathiassen, 1958). Such an *in situ* development of Dorset culture in the Eastern Arctic with possibly the addition of some diffused traits has been suggested by Taylor (Taylor, 1959, p. 18).

COMPARISON WITH ASSEMBLAGES FROM OTHER SITES

The various assemblages from the vicinity of Lake Harbour, treated here, appear to be part of the Arctic Small Tool Tradition (Irving, 1957) and bear a generic link with such assemblages as Denbigh (Giddings, 1951), Dismal-2 (Harp, 1958), New Mountain (MacNeish, 1959), T-1 (Collins, 1956a, 1956b, 1957), Thyazzi (Giddings, 1956), Alarnerk (Meldgaard, 1960), Ivugivik (Taylor, n.d.), Sarqaq (Larsen and Meldgaard, 1958;

Mathiassen, 1958), and Independence I (Knuth, 1952, 1954, 1958). The closest link—geographically, typologically, and in terms of percentage frequencies—seems to be the Ivugivik assemblage (Taylor, n.d.). If the percentage frequencies of artifacts from Ivugivik are indicated on a histogram of frequencies from the Lake Harbour sites, the Ivugivik assemblage fits neatly in the seriation between the Annawalk and Killilugak sites. The outstanding differences between the Lake Harbour assemblages and the ones from Ivugivik are the differences in raw materials (possibly related to available sources) and in the end blades, side blades, and knives, both in terms of typology and percentage frequencies. It may be significant that the greatest point of difference between the Annawalk assemblage and the Thyassi assemblage is also in end blade, side blade, and knife types, and in frequencies. This suggests the possibility that these artifacts, particularly the side blades, have a different rate and course of diffusion than have tools related to the burin industry. This comparative treatment of assemblages suggests also that microblades diffused into the Eastern Arctic independently of the burin industry and may have reached Greenland only at about the beginning of the Christian Era.

The "fit" between Ivugivik assemblages and Lake Harbour assemblages is so close that one is tempted to see the relationship as chronological; i.e., that Ivugivik is younger than Annawalk and older than Killilugak. However, there is a wide discrepancy between their respective sea-level elevations. The three Ivugivik sites have a minimum elevation of 105 feet above high tide, whereas the Annawalk Site is only 60 feet above high tide. To assume equal rates of eustatic readjustment would imply a wide time difference between the sites. However, we suggest here that the difference is due, rather, to differential rates of isostasy and related factors of earth crust mechanics. A number of geomorphologists (summarized in Sim, 1960) have suggested that greater weights of ice covered the perimeter of Hudson Bay and the Melville Peninsula than covered the south shore of Baffin Island, and that during the Post-Wisconsin ice retreat southern Baffin Island may have been cleared of ice some thousands of years before such locations as Ivugivik and Alarnerk existed. One would expect, then, greater crustal movements in these regions, higher emerged beach lines, and a greater *apparent* age of emergence. I suggest that the complex problem of Post-Wisconsin chronology in this region can be partially solved by an interchange between geomorphological and archaeological data (cf., Blackadar, 1958). For example, statistically, I would suggest that an elevation of 55 to 57 feet near Lake Harbour equates in time with an elevation of 105 feet at Ivugivik on the northwestern corner of Hudson Strait.

The apparent cultural relationship between the Lake Harbour assemblages and the Dismal-2 assemblage also appears to be close (*see* Figure 3), but in view of the vast geographical distance between the two sites one hesitates to draw strong inferences of chronological relationship. Comparisons with the Proto-Dorset assemblage at T-1 (Collins, 1956a, 1956b, 1957) and at Sarqaq appear to be less close. (The detailed comparisons between Ivugivik and Sarqaq in Taylor, n.d., apply here, and I will not repeat them.) I suspect that many factors, including sample sizes and regional specializations, are involved here. Unfortunately a detailed description of the pre-Dorset to Dorset continuum from Alarnerk is not yet

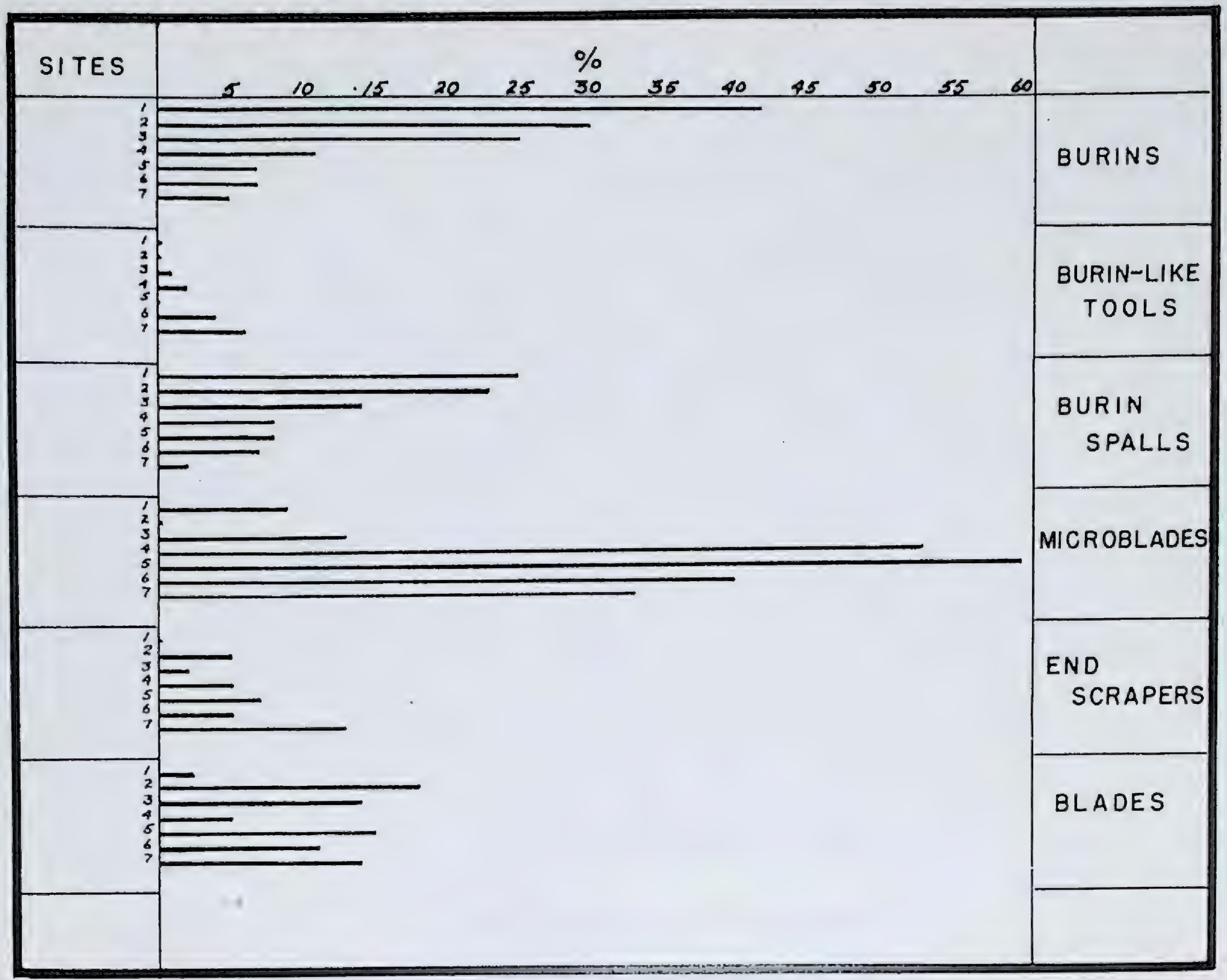

FIGURE 3. Percentage frequencies of key artifacts from seven Arctic assemblages: (1) Annawalk Site, (2) Thyazzi Site, North Knife River, Manitoba (after Giddings, 1956), (3) Ivugivik Site, Ungava (after W. E. Taylor, n.d.), (4) Killalugak Site, (5) Dismal Lake-2, Northwest Territories (after Harp, 1958), (6) Davidee Site, (7) Sandy Site.

available. Published descriptions (Meldgaard, 1960) suggest many dissimilarities. However, the Lake Harbour assemblages do tend to reinforce Meldgaard's statement that ground slate artifacts appear earlier in the continuum than previously suspected.

SUMMARY AND CONCLUSIONS

In the month of August a field expedition of the National Museum of Canada recovered a total of 473 artifacts from eight sites in two vicinities, 10 and 20 miles, respectively, southeast of Lake Harbour, Baffin Island, Northwest Territories. The sites, both typologically and in terms of elevation above present high tide, appear to belong to five different time periods. When these sites are arranged in order of their height above the present high tide, a comparison of percentage frequencies of artifact types in the various site assemblages demonstrates a consistent seriation.

In summary, the Annawalk Site (and the KeDr-2 site) at an elevation of 60 feet is oldest. Tools are predominantly of chert; the burin industry (unifacially-worked blade and flake, and bifacially-worked blade burins and burin spalls) accounts for 67 per cent of the total assemblage. There are few other types of tools. End blades are very rare; microblades which are infrequent are not skilfully made.

The Killilugak Site at an elevation of 33 feet 6 inches is next in time. Its assemblage shows significant increases in the use of quartz crystal, in polished artifacts, bifacially-worked end blades and knives, and end scrapers. The increase in the frequency of microblades is so dramatic that it suggests the infusion of a major tool tradition. On the other hand, there is a marked reduction in the importance of the burin industry (19 per cent).

The Davidee Site (as well as the Niggierk and Nipaluktok Sites) at an elevation of 29 feet is next oldest. Its assemblage marks the dominance of quartz crystal as an artifact material and the appearance of hafted burins, hafted microblades, triangular end blades, and the oval steatite lamp. The burin industry, on the other hand, is reduced to 14 per cent of the total assemblage.

The Sandy Site, at an elevation of 18 feet, demonstrates an increasing number of stone tools usually considered "Dorset" in Eastern Arctic assemblages. Small, serrated-edged end blades first appear, as do small side-notched projectile points which seem to have cultural links with Newfoundland. End scrapers increase significantly in frequency, and this assemblage marks the first appearance, in this group of sites, of the flared end scraper.

The Tiriak Site, at an elevation of 12 feet, has produced in a preliminary investigation only 14 artifacts. Few meaningful statements can be made, therefore, about its assemblage. The two most significant artifacts are a triangular, serrated-edged end blade and a crude, rubbed slate pebble adze. The preservation of bone at this site is sufficiently good to warrant recovery of artifacts in subsequent work.

The five assemblages discussed appear to demonstrate an unbroken cultural continuum from a Cape Denbigh-like pre-Dorset period to the beginning of Dorset culture. Datable carbon material was recovered from three of the sites—Annawalk, Davidee, and Sandy—and assessment of these samples should provide us with dates for the key points in this continuum. The earlier Lake Harbour assemblages appear to be most nearly comparable with the assemblage from Ivugivik which Taylor has provisionally dated at 1500 B.C. (Taylor, n.d.). This figure, as an estimate, appears to me to be in the right order of magnitude and suggests that the Lake Harbour continuum began shortly before the Ivugivik complex (2000 B.C.?) and lasted into the first or second century before Christ.

If the Ivugivik and Annawalk assemblages can, in fact, be equated in time, they provide illuminating data on the differential rates of isostatic and eustatic readjustment in the Eastern Arctic. The implication is that for about two millenia, land at the northwestern tip of the Ungava Peninsula rose twice as rapidly as did the southeastern shore of Baffin Island.

We conclude, admittedly from a presently small sample, that Dorset Culture developed in the Eastern Arctic from a general Arctic Small Tool–Cape Denbigh base. Elements which contribute to the *in situ* development of Dorset culture seem to have differential rates of diffusion to the Eastern Arctic and perhaps different courses of diffusion. The Lake Harbour sample does not provide proof of the northward diffusion of traits from Boreal Indian assemblages, but some of the artifacts suggest links to the south, particularly to Newfoundland.

Additional work in the vicinity, projected for 1962, should provide further data to illuminate some of the moot points discussed here.

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Plate I

Burins and Burin-like Tools from Four Sites
in the Lake Harbour vicinity

(Arrows and ticks represent direction of burin blow and number of burin scars.)

Figure A. Burin on unifacially-worked blade. Site KeDr-1, surface.
Figure B. Burin on unifacially-worked blade. Site KeDr-1 level 1.
Figure C. Multiple burin on unifacially-worked blade. Site KeDr-1, level 1.
Figure D. Burin on unifacially-worked blade. Site KeDr-1, level 1.
Figure E. Burin on bifacially-worked blade. Site KeDr-1, level 1.
Figure F. Hafted multiple burin on bifacially-worked blade. Site KdDq-1, surface.
Figure G. Hafted burin on bifacially-worked blade. Site KdDq-1, surface.
Figure H–J. Hafted burins on bifacially-worked blades. Site KdDq-2 (?), Davidee's collection.
Figure K. Hafted burin on retouched microblade. Site KdDq-2, layer 1.
Figure L, M. Burin-like tools with polished facets. Site KdDq-2, layer 2.
Figure N. Burin-like tool. Site KdDq-2, layer 2.
Figure O. Burin-like tool. Site KdDq-2, layer 3.
Figure P. Burin-like tool. Site KdDq-2 (?), Davidee's collection.
Figure Q. Burin-like tool, polished facet on quartzite flake. Site KdDq-1, surface.
Figure R. Burin-like tool (?), polished slate. Site KeDr-3, layer 1.
Figure S. Burin-like tool. Site KdDq-1, surface.
Figure T. Burin-like facet on triangular blade. Site KdDq-1, surface.
Figure U. Burin-like tool. Site KdDq-1, surface.

PLATE I

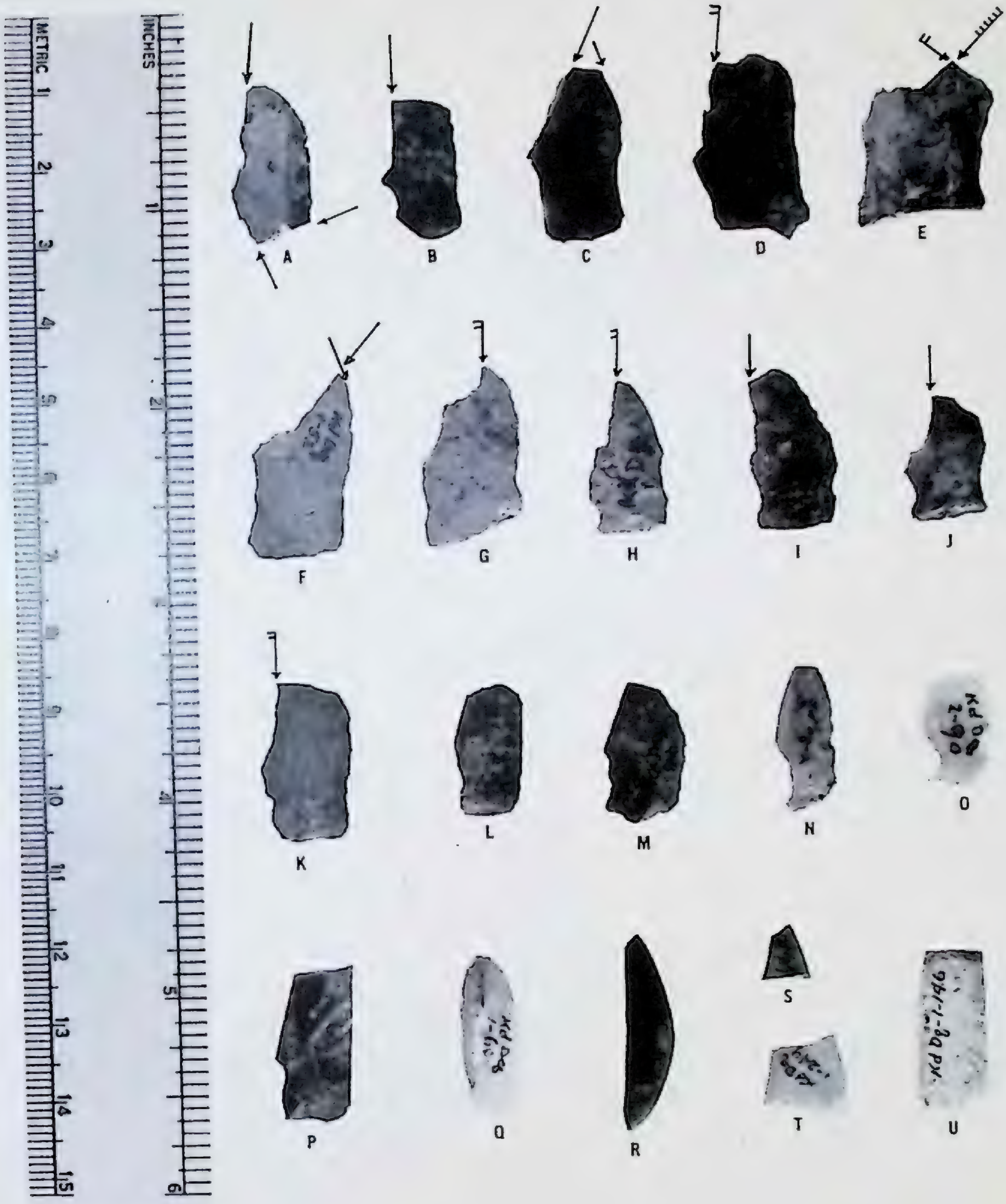

Plate II

Burins from Sites KeDr-1 (Annawalk) and KeDr-2

Figure A. Burin on bifacially-worked blade. Site KeDr-1, level 1.
Figure B. Burin on unifacially-worked blade. Site KeDr-1, level 1.
Figure C. Burin blank on bifacially-worked blade. Site KeDr-1, surface.
Figure D. Burin on unifacially-worked blade. Site KeDr-1, level 1.
Figure E. Burin on bifacially-worked blade. Site KeDr-1, level 1.
Figure F, G. Burins on bifacially-worked flakes. Site KeDr-1, surface.
Figure H. Burin on bifacially-worked blade. Site KeDr-1, level 1.
Figure I. Burin on unifacially-worked blade. Site KeDr-1, level 1.
Figure J. Burin on unifacially-worked blade. Site KeDr-1, surface.
Figure K. Burin on unifacially-worked blade. Site KeDr-1, level 1.
Figure L. Burin on unifacially-worked flake. Site KeDr-1, level 1.
Figure M. Burin on bifacially-worked blade. Site KeDr-1, level 1.
Figure N. Burin on unifacially-worked blade. Site KeDr-2, surface.
Figure O. Burin on microblade-like flake. Site KeDr-1, surface.
Figure P. Burin on unifacially-worked flake. Site KeDr-1, level 1.
Figure Q. Burin on unifacially-worked side scraper. Site KeDr-1, level 1.
Figure R, S. Burins on unifacially-worked flakes. Site KeDr-1, level 2.

PLATE II

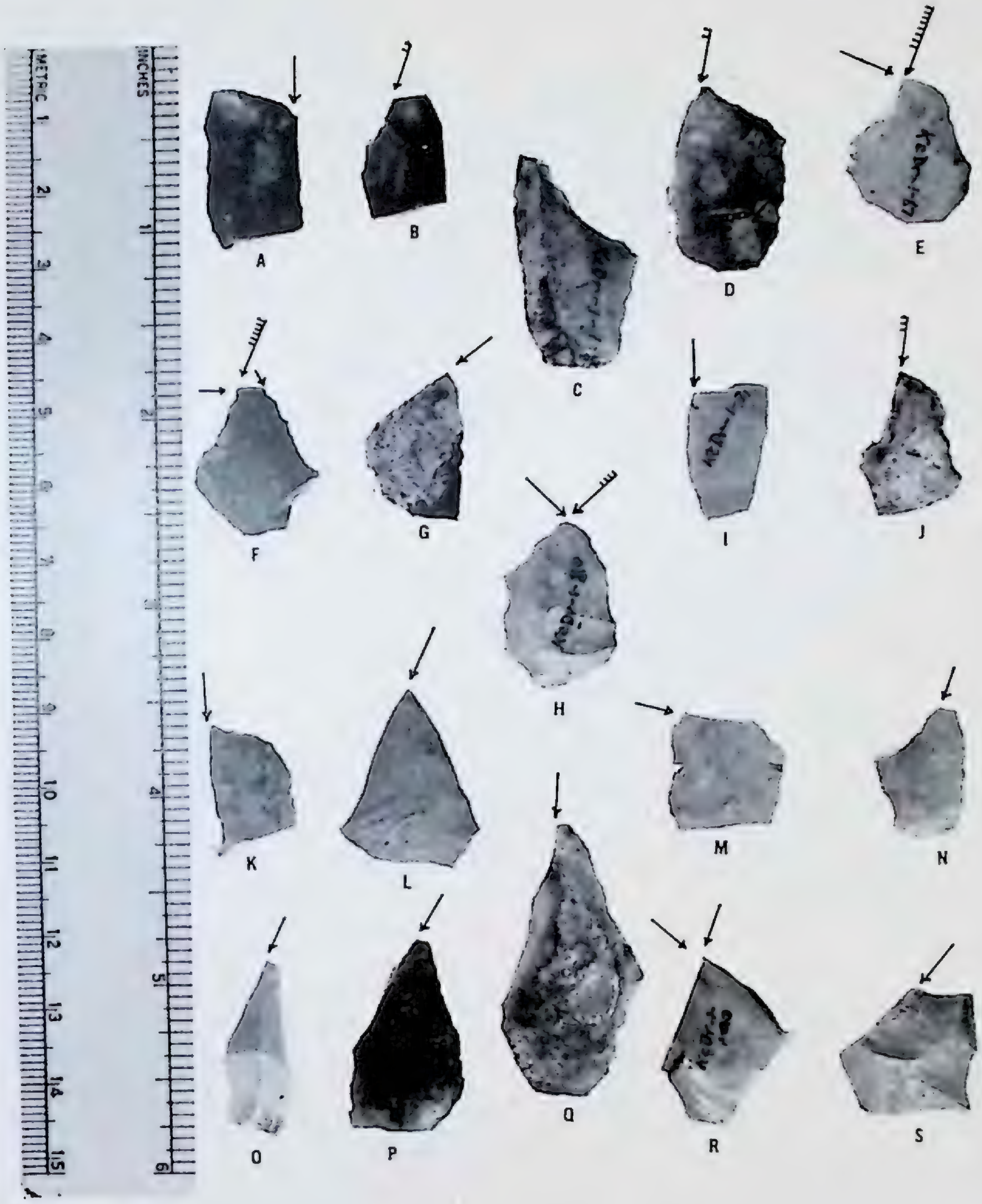

Plate III

Artifacts from the Annawalk Site (KeDr-1)

Figure A. Unifacially-worked side scraper and burin. Site KeDr-1, level 2.
Figure B. Flake knife and burin. Site KeDr-1, surface.
Figure C. Retouched flake. Site KeDr-1, surface.
Figure D. Retouched flake. Site KeDr-1, level 1.
Figure E. Basal fragment of an end blade. Site KeDr-1, level 1.
Figure F. Medial fragment of unifacially-worked end blade (?). Site KeDr-1, level 1.
Figure G. Burin on primary burin spall. Site KeDr-1, level 1.
Figure H. Quartz crystal microblade with retouched edges. Site KeDr-1, level 1.
Figure I. Quartz crystal microblade-like flake. Site KeDr-1, surface.
Figure J. Quartz crystal perforator. Site KeDr-1, surface.
Figure K. Quartz crystal microblade-like flake. Site KeDr-1, level 1.
Figure L. Primary burin spall. Site KeDr-1, level 1.
Figure M, N. Secondary burin spalls. Site KeDr-1, level 1.
Figure O. Primary burin spall. Site KeDr-1, level 1.
Figure P–S. Secondary burin spalls. Site KeDr-1, level 1.

PLATE III

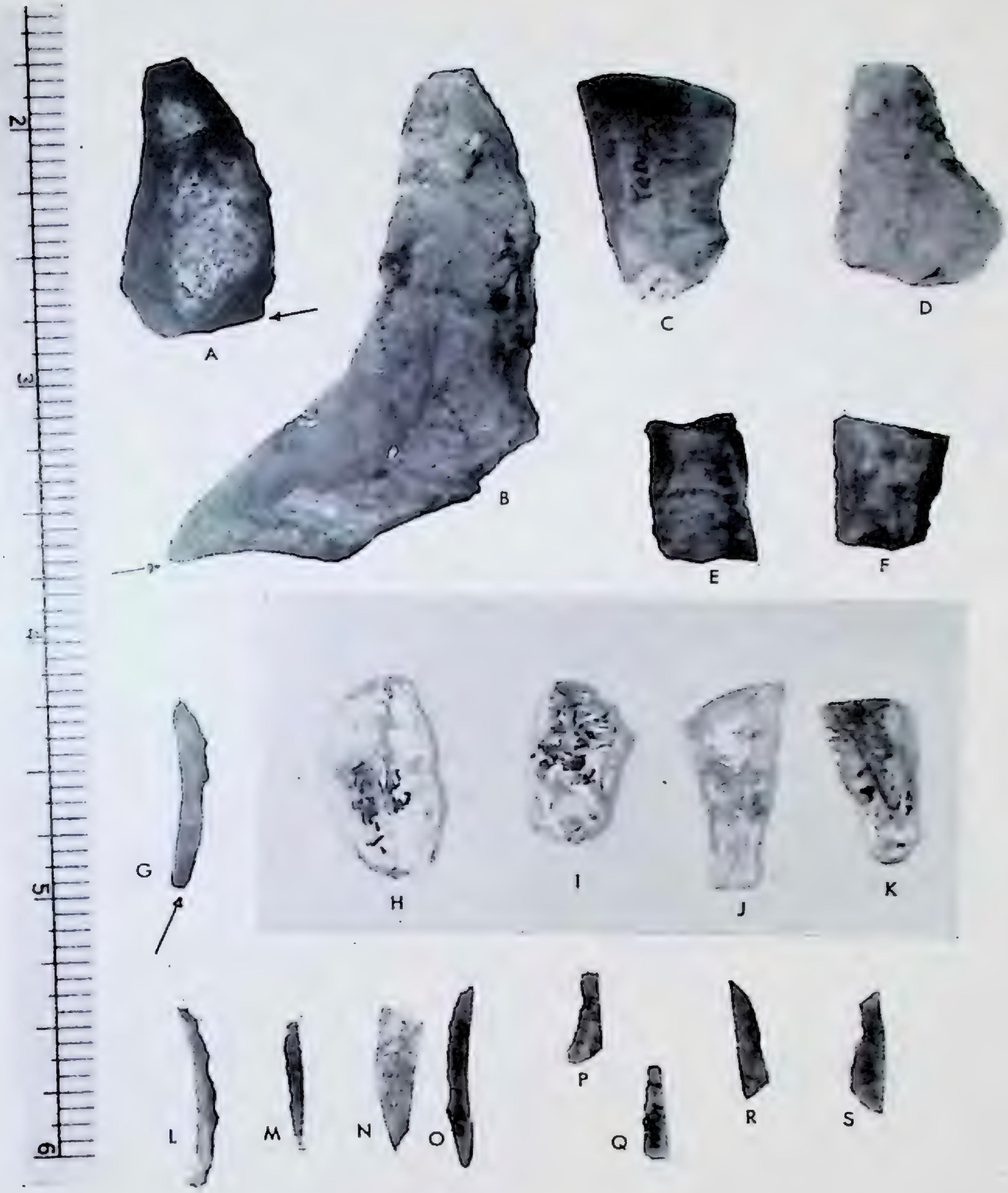

Plate IV

Artifacts from the Killalugak Site (KeDr-3)

Figure A. Fragment of bifacially-worked, asymmetrical knife. Site KeDr-3, level 2.
Figure B. Basal fragment of end blade. Site KeDr-3, level 1.
Figure C. Basal fragment of end or side blade secondarily used as a burin. Site KeDr-3, level 1.
Figure D. Chert microblade. Site KeDr-3, level 1.
Figure E. Bifacially-worked multiple burin. Site KeDr-3, level 1.
Figure F. Retouched flake. Site KeDr-3, level 1.
Figure G. Fragment of chert core. Site KeDr-3, level 2.
Figure H. Chert microblade. Site KeDr-3, level 1.
Figure I. Chert microblade with retouched edges. Site KeDr-3, level 1.
Figure J. Quartzite microblade. Site KeDr-3, level 1.
Figure K. Chert microblade. Site KeDr-3, level 1.
Figure L. Chert microblade. Site KeDr-3, level 2.
Figure M. Chert microblade. Site KeDr-3, level 1.
Figure N. Primary burin spall. Site KeDr-3, level 1.
Figure O. Secondary burin spall, ground and polished. Site KeDr-3, level 1.
Figure P. Primary burin spall. Site KeDr-3, level 1.
Figure Q. Tip of end blade. Site KeDr-3, level 1.
Figure R. Side-notched quartz crystal microblade. Site KeDr-3, level 1.
Figure S–U. Quartz crystal microblades. Site KeDr-3, level 1.
Figure V. Retouched flake with scraper edge. Site KeDr-3, level 1.

Plate IV

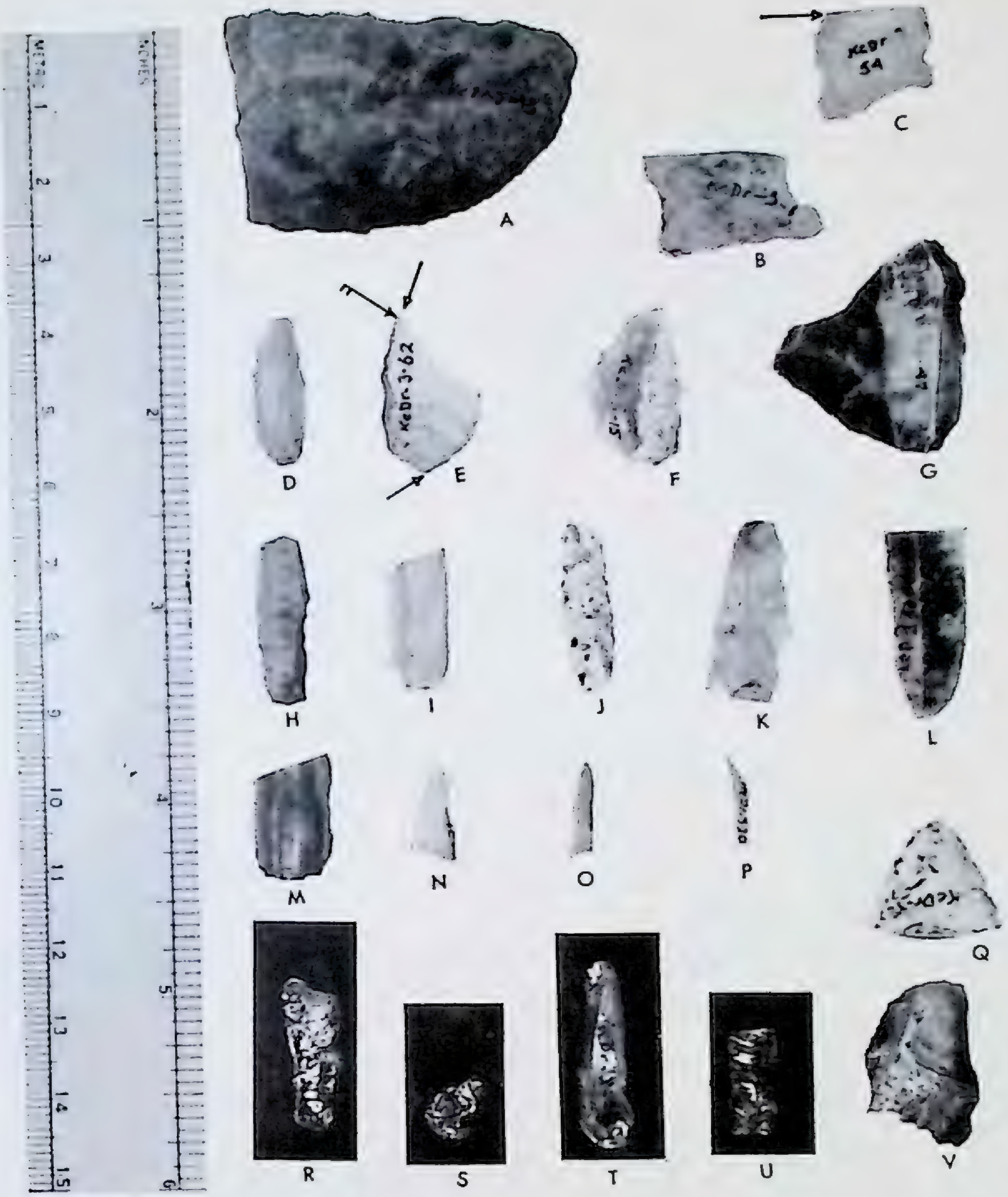

PLATE V

Artifacts from the Davidee Site (KdDq-1)

FIGURE A. Slate flake knife with ground edges. Site KdDq-1, surface.
FIGURE B. Chert ovate end blade. Site KdDq-1, surface.
FIGURE C. Chipped slate projectile point or end blade. Site KdDq-1, surface.
FIGURE D. Chert asymmetrical side blade. Site KdDq-1, surface.
FIGURE E. Quartz crystal end blade. Site KdDq-1, layer 2.
FIGURE F. Quartz transverse-edged side blade. Site KdDq-1, surface.
FIGURE G. Bifacially-worked hafted burin. Site KdDq-1, surface.
FIGURE H. Chert end blade. Site KdDq-1, surface.
FIGURE I. Black quartzite end or side blade. Site KdDq-1, surface.
FIGURE J. Quartz crystal end blade. Site KdDq-1, surface.
FIGURE K. Slate side-notched end blade. Site KdDq-1, layer 2.
FIGURE L. Medial fragment of ground slate end blade. Site KdDq-1, layer 2.
FIGURE M. Quartz crystal end scraper. Site KdDq-1, layer 1.
FIGURE N. Burin on unifacially-worked blade. Site KdDq-1, Cooch collection.
FIGURE O. Burin on flake. Site KdDq-1, surface.
FIGURE P. Multiple burins on flake. Site KdDq-1, layer 2.
FIGURE Q. Burin on end of a scraper. Site KdDq-1, layer 2.
FIGURE R. Chert end scraper. Site KdDq-1, layer 1.
FIGURE S. Quartz crystal end scraper. Site KdDq-1, layer 1.
FIGURE T. Primary burin spall. Site KdDq-1, surface.
FIGURE U–X. Secondary burin spalls. Site KdDq-1, surface.
FIGURE Y, Z. Burin-like tools. Site KdDq-1, surface.
FIGURE AA. Burin-like tool. Site KdDq-1, surface.
FIGURE BB. Quartz crystal perforator. Site KdDq-1, surface.
FIGURE CC. Medial fragment of a quartz crystal perforator. Site KdDq-1, surface.
FIGURE DD. Chert microblade, retouched. Site KdDq-1, surface.
FIGURE EE. Chert microblade. Site KdDq-1, surface.
FIGURE FF. Chert microblade. Site KdDq-1, layer 2.
FIGURE GG–MM. Quartz crystal microblades. Site KdDq-1, surface.

PLATE V

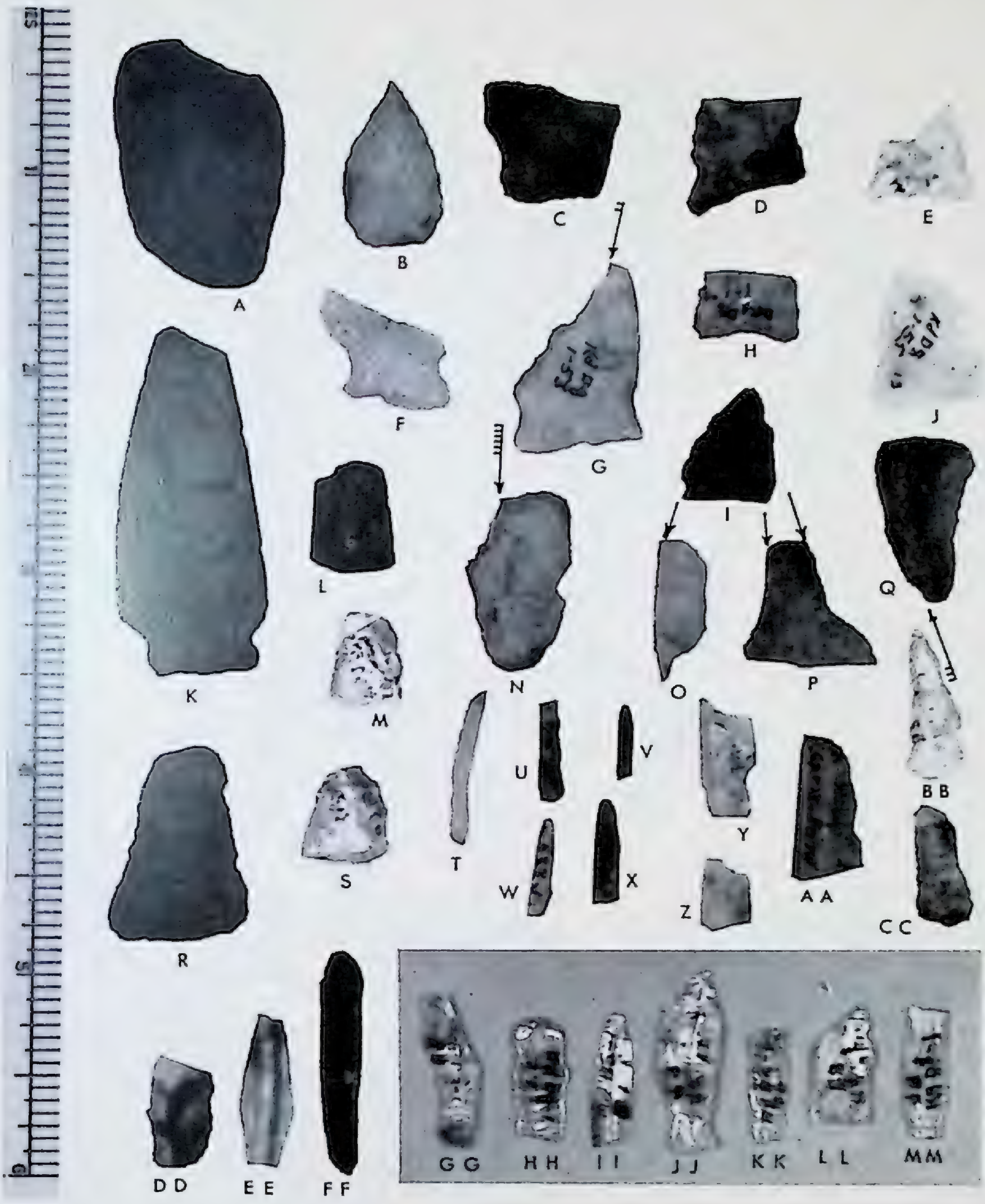
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Plate VI

Artifacts from the Sandy Site (KdDq-2)

Figure A. Burin on unifacially-worked flake. Site KdDq-2, layer 1.
Figure B. Burin on unifacially-worked blade. Site KdDq-2, layer 1.
Figure C. Burin on unifacially-worked flake. Site KdDq-2, layer 2.
Figure D. Burin-like tool, broken. Site KdDq-2, layer 3.
Figure E. Chert microblade. Site KdDq-2, layer 2.
Figure F. Chert microblade. Site KdDq-2, surface.
Figure G. Chert core remnant. Site KdDq-2, layer 3.
Figure H, I. Fragments of burin-like tools. Site KdDq-2, layer 2.
Figure J. Secondary burin spall. Site KdDq-2, layer 1.
Figure K. Primary burin spall. Site KdDq-2, surface.
Figure L, M. Chert microblades. Site KdDq-2, layer 2.
Figure N. Chert microblade. Site KdDq-2, layer 1.
Figure O. Chert hafted microblade. Site KdDq-2, layer 3.
Figure P. Quartz crystal microblade. Site KdDq-2, layer 3.
Figure Q. Quartz crystal hafted microblade. Site KdDq-2, layer 1.
Figure R. Quartz crystal microblade. Site KdDq-2, layer 2.
Figure S. Quartz crystal hafted microblade. Site KdDq-2, layer 1.
Figure T. Quartz crystal microblade. Site KdDq-2, layer 3.
Figure U. Quartz crystal microblade. Site KdDq-2, surface.

Plate VI

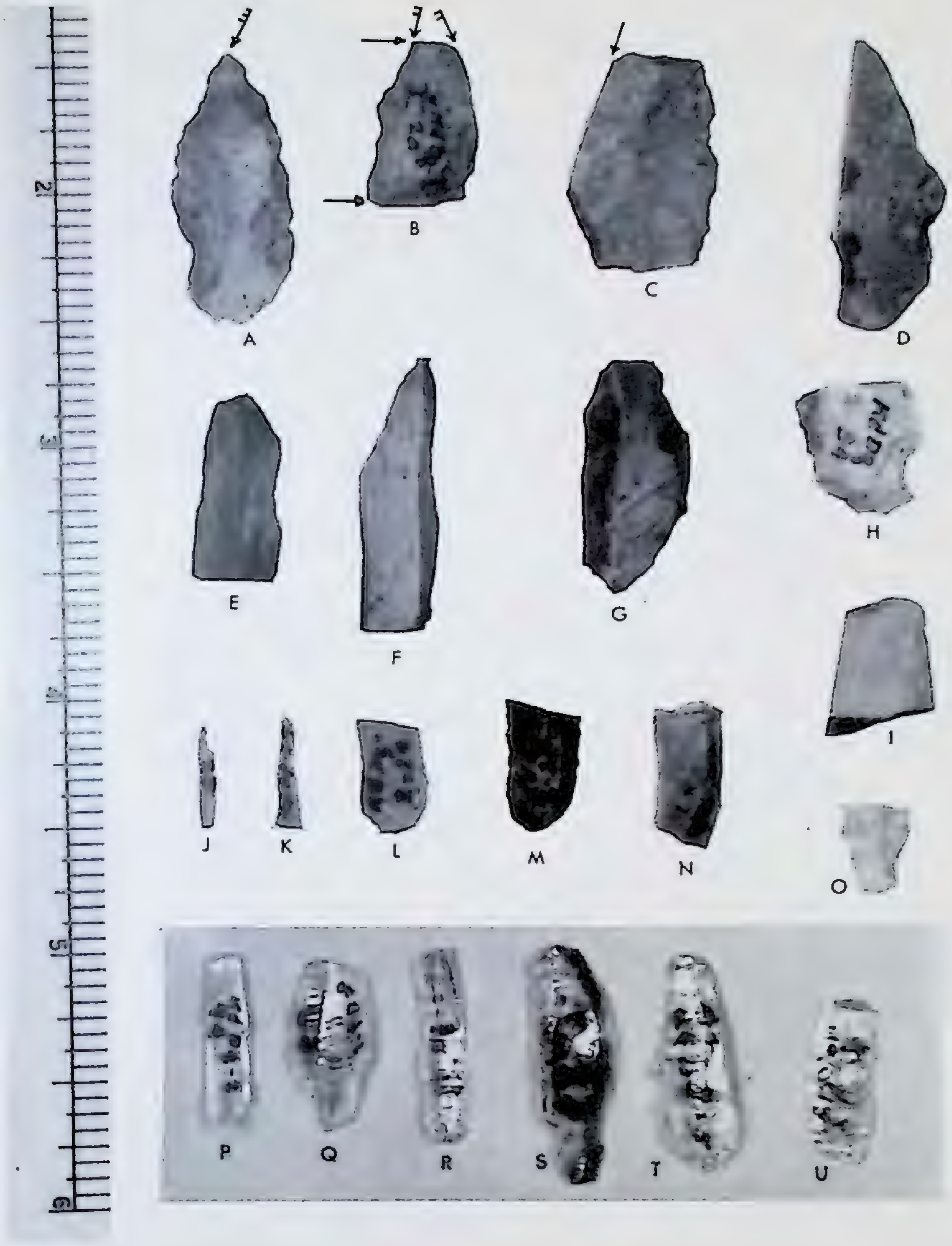
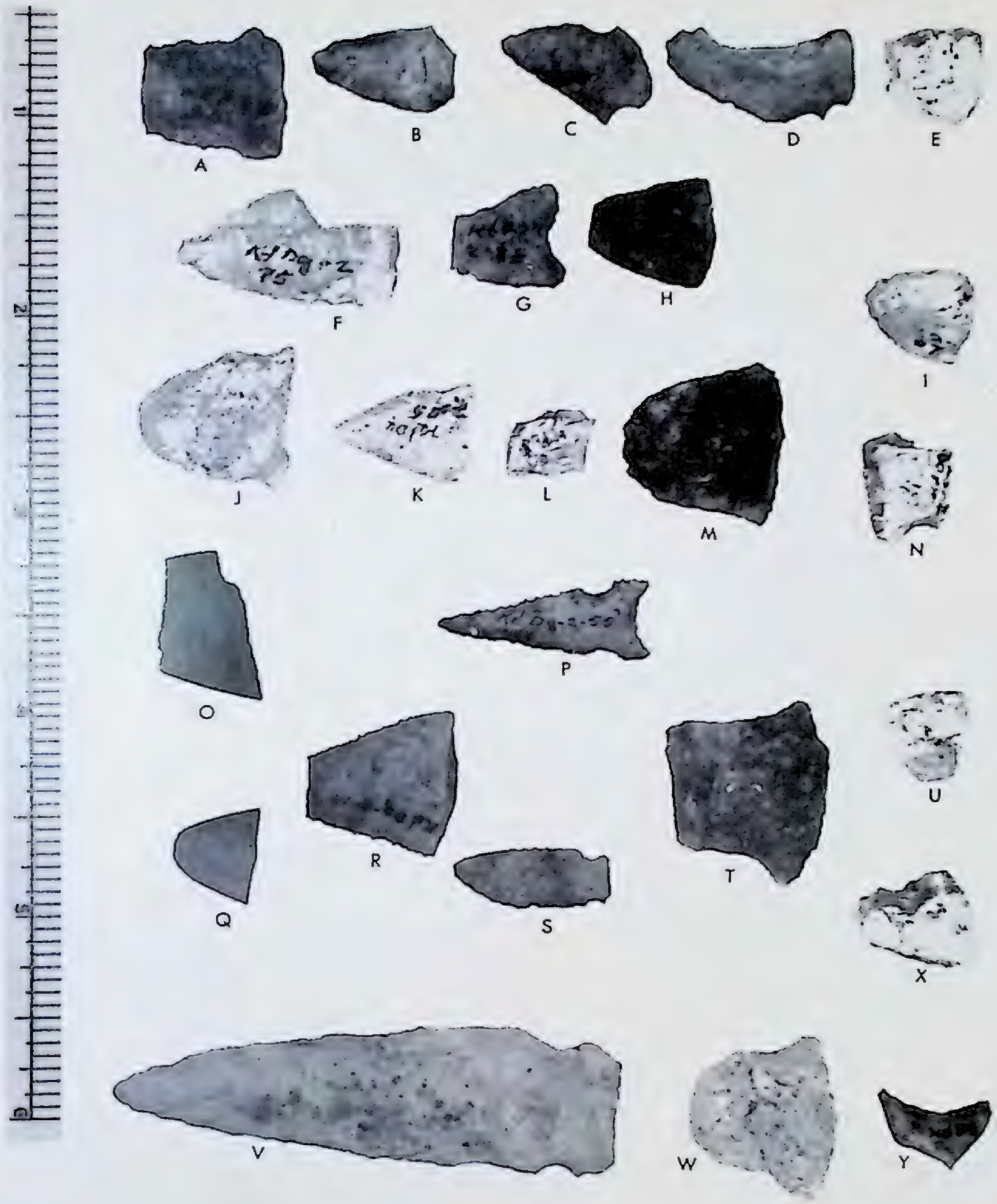


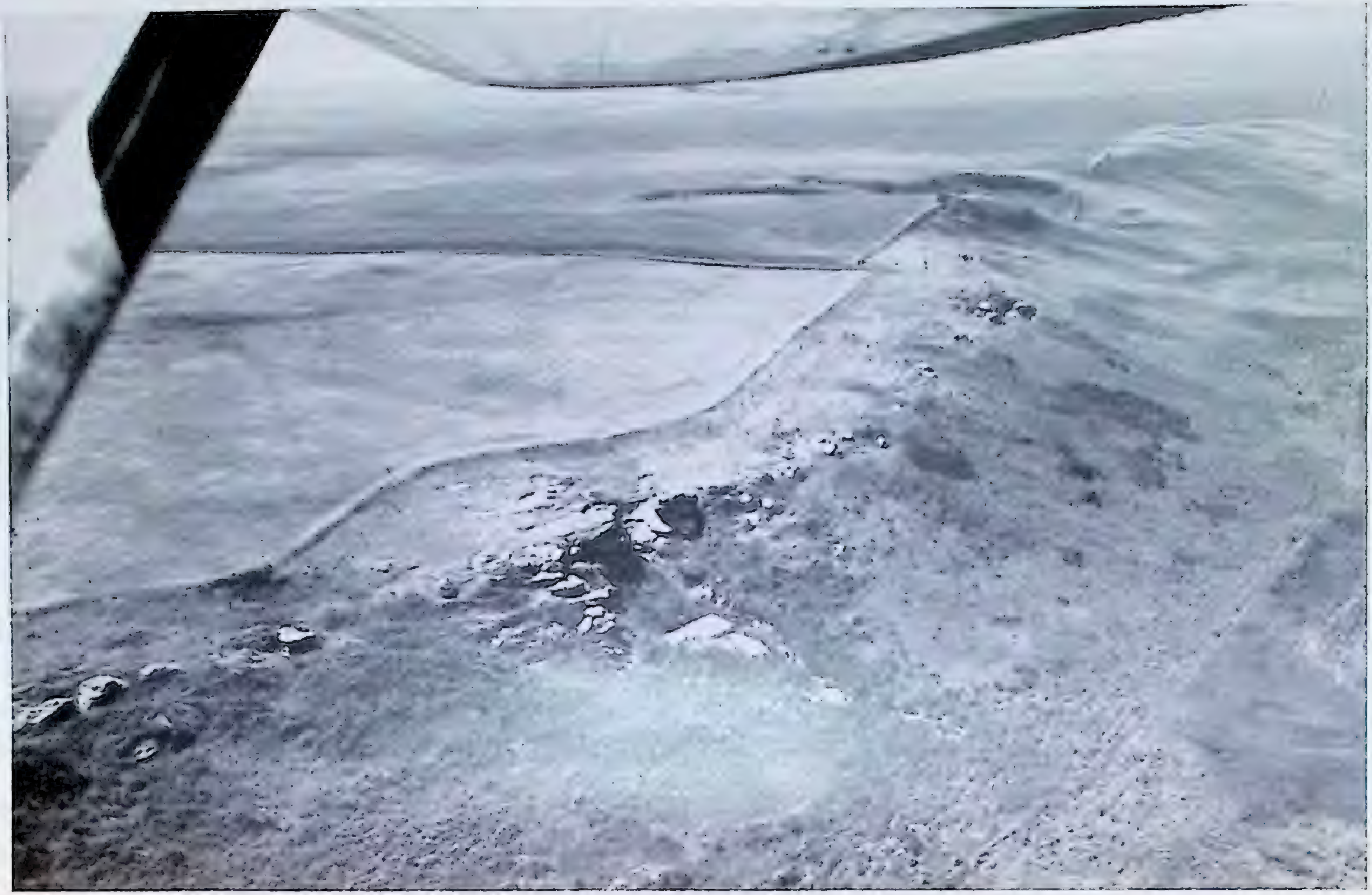
Plate VII

Artifacts from the Sandy Site (KdDq-2)

Figure A. Chert projectile point or end blade fragment with serrated edges. Site KdDq-2, layer 1.
Figure B. Chert projectile point or end blade on unifacially-worked chert flake. Site KdDq-2, layer 3.
Figure C. Transverse-edged side blade. Site KdDq-2, layer 1.
Figure D. Notched side blade or side scraper. Site KdDq-2, layer 1.
Figure E. Quartz crystal end scraper. Site KdDq-2, layer 2.
Figure F. Quartz crystal end blade with serrated edges. Site KdDq-2, layer 2.
Figure G. Chert end blade. Site KdDq-2, layer 2.
Figure H. Chert end scraper. Site KdDq-2, layer 1.
Figure I. Quartz crystal end scraper. Site KdDq-2, layer 1.
Figure J. Quartz crystal end blade. Site KdDq-2, layer 1.
Figure K. Quartz crystal end blade with finely serrated edges. Site KdDq-2, layer 1.
Figure L. Quartz crystal end blade fragment with finely serrated edges. Site KdDq-2, layer 3.
Figure M. Amorphous quartz end scraper. Site KdDq-2, layer 3.
Figure N. Quartz crystal hafted end scraper. Site KdDq-2, layer 1.
Figure O. Medial fragment of ground slate end blade. Site KdDq-2, layer 2.
Figure P. Chert projectile point with finely serrated edges. Site KdDq-2, layer 3.
Figure Q. Tip of ground slate end blade. Site KdDq-2, surface.
Figure R. Medial fragment of chert end blade with finely serrated edges. Site KdDq-2, layer 1.
Figure S. Asymmetrical, side-notched side blade. Site KdDq-2, layer 3.
Figure T. Amorphous quartz end scraper. Site KdDq-2, layer 1.
Figure U. Quartz crystal end scraper. Site KdDq-2, layer 1.
Figure V. Chert projectile point or end blade. Site KdDq-2, surface.
Figure W. Amorphous quartz end scraper. Site KdDq-2, layer 1.
Figure X. Quartz crystal end scraper. Site KdDq-2, layer 1.
Figure Y. Chert concave side scraper. Site KdDq-2, layer 2.

PLATE VII





Aerial view of the Old Women's Buffalo Jump (centre), looking southwest, taken following excavations. A prehistoric camp area is in the meadow at the lower right-hand corner. Outcrops at the lower left-hand corner mark the site of a secondary bison kill.

THE OLD WOMEN'S BUFFALO JUMP, ALBERTA

By Richard G. Forbis*

INTRODUCTION

Discovery and Location

During the summer of 1952, great torrents of water ripped their way, in a flash flood, down the slopes of Squaw Coulee between the outcrops of Paskapoo sandstone which formed the cliffs over which buffalo had once been driven to their death. The waters tore out a gully some 12 feet wide and in some places as deep, exposing many buried bone and soil beds and leaving a white sheet of bones in the meadow below.

This sheet of bones almost immediately attracted the attention of Webb Sloane, who farms the land. News of the discovery was soon widely circulated around the locality.

Fortunately, the jump came to light only after the time when many similar deposits were ransacked for commercial reasons. The bone had proved economically useful in sugar refining and as fertilizer. As a result, most buffalo kills in the area are badly disturbed, if not destroyed, and consequently their scientific value is regarded as scant.

The Old Women's Buffalo Jump (EcPl-1 in the Uniform Site Designation Scheme for Canada), or Cayley Kill, is located on the south bank of Squaw Coulee, about 2 miles northwest of the town of Cayley and some fifty miles south of Calgary, Alberta (Figure 1). It consists of low cliffs of Paskapoo sandstone, below which there is an extensive fan-shaped deposit of bone on a slope that faces north and slightly east (Plate I). The bone deposit, marked off from less fertile soil by a lush growth of tall rye grass, is more than 100 feet wide and extends downhill about 200 feet from the base of the cliffs to the bottom of the fan (Figure 2). The present drop in the cliffs is some 20 to 25 feet (Plate III). It must have been progressively greater in earlier times, before the deposition of bone and soil layers. It is approximately 80 feet from the top of the cliffs to the bottom of the fan, in the meadow. Although the Women's Jump is not particularly large, it was clearly one of intensive use.

Acknowledgments

After the discovery in 1952 of the Old Women's Buffalo Jump, many residents in and around the Cayley district took an interest in it. Donald R. King photographed it and sent his pictures and notes to Dr. Douglas Leechman, who was then with the National Museum of Canada. Shortly afterward, Leechman joined the Glenbow Foundation, and later the Foundation directed its attention to the excavation and preservation of the site.

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*Staff Archaeologist, Glenbow Foundation, Calgary, Alberta.

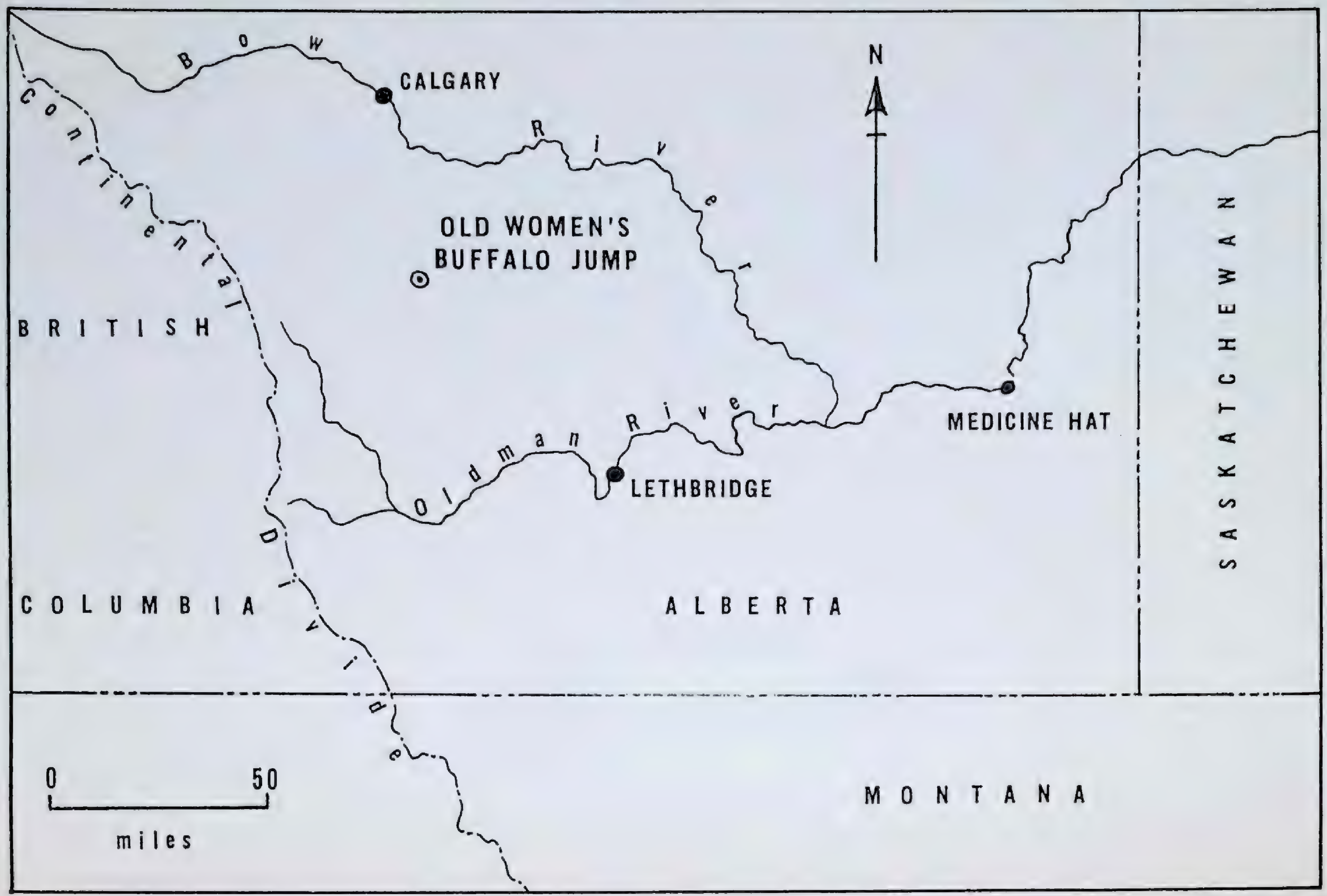


Figure 1. Sketch map of Southern Alberta.

During the summer of 1957, T. J. O'Leary, David Quapp, and the author conducted minor tests in the valley of Squaw Coulee, below the cliffs which mark the site of the Old Women's Buffalo Jump. In the bottom, a concentrated bed of buffalo bone (which no doubt represents a campsite associated with the jump) was found to extend for over 500 feet on either side of the cliffs. The bones rest in a sticky bog soil; ground water that lies at a depth of about two feet below the surface retards excavation to any significant depth.

A field party from the Glenbow Foundation set to work in the upper pit of the Old Women's Jump on May 14, 1958, and remained there for about three months, through the middle of August. In the beginning, David Quapp served with more than ordinary competence as field supervisor, assisted ably by D. R. King and Jacob Hubert. To these men must go credit for their alert recognition of the stratigraphy and for their initial observations, especially Hubert's, on the changes in projectile points, layer by layer. As excavations proceeded, circumstances necessitated replacements in personnel. About July 1, King took charge of field work; Kenneth Smith, Norman and Edward Richards, and Norman Ring succeeded Quapp and Hubert. King and Smith were the last to leave the site, after erecting a durable structure over the pit to prevent erosion of the walls.

In 1959 excavations were resumed, this time at the lower pit, about 40 feet downhill from excavations of the previous summer. A number of persons participated in this work, including King, Smith, Merlin Dobry, Clive Elliott (volunteer), and Phyllis Bowland, with Tyler Bastian in charge of the field work. This project continued from about the first of June to the middle of July.

The excavations could not have taken place without the freely-given consent of Mr. J. A. Sloane, owner of the land, and his brother, Webb Sloane, who farms it. Both have been exceptionally generous in their attitude toward the excavations, and they have been most helpful in other respects. Nor could the work have been successfully completed without the unstinting support of the officers and staff of the Glenbow Foundation. Mrs. Vera Burns drafted many of the charts, and Mrs. Carol McDermott typed the final draft for publication. Many persons, too numerous to mention individually, expressed a deep interest in the project; they assisted in many ways which they did not, perhaps, fully realize. Reference will be made to some of these persons throughout the following pages. Dr. R. S. MacNeish, Mr. Hugh A. Dempsey, Dr. Douglas Leechman, and Mr. Tyler Bastian offered many helpful suggestions on the original draft of this manuscript.

Much of value has been added to this report through the courtesy of the Hudson's Bay Company in granting permission to quote extracts from Peter Fidler's "Journal of a Journey over Land from Buckingham House to the Rocky Mountains, in 1792 & 3," a manuscript in the archives of the Company. Hugh A. Dempsey, archivist for the Glenbow Foundation, first directed the author's attention to this work. The offices of the Smithsonian Institution, River Basin Surveys in Lincoln, Nebraska, kindly allowed the Glenbow Foundation to copy its valuable manuscript on *Buffalo Kills in Montana*, by H. P. Lewis. The author is grateful also to the Laboratory of Anthropology, University of Nebraska, Lincoln, for access to the Plains file of the Cross-Cultural Survey.

CONTOUR MAP
OLD WOMEN'S BUFFALO JUMP

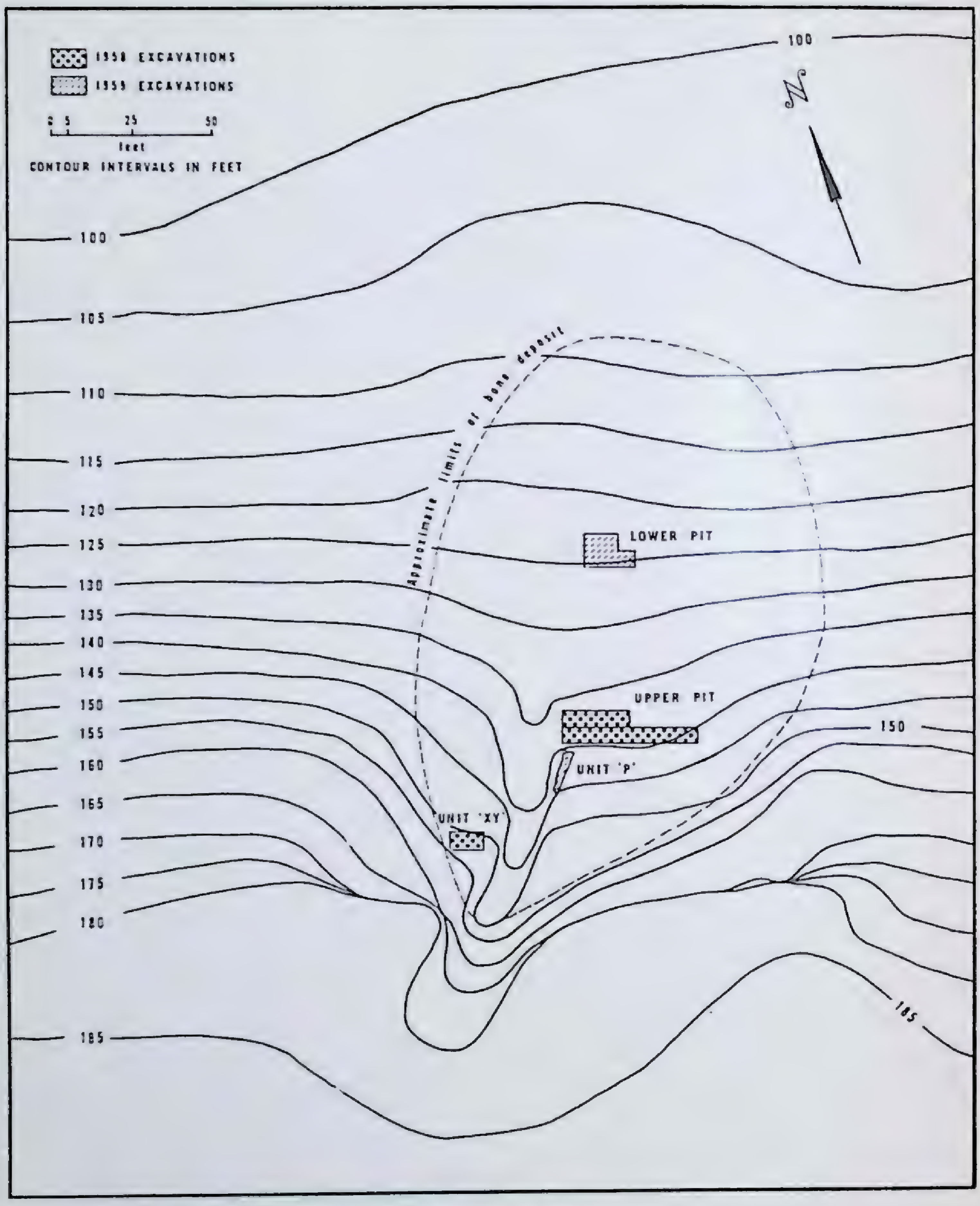


FIGURE 2

MYTHOLOGY

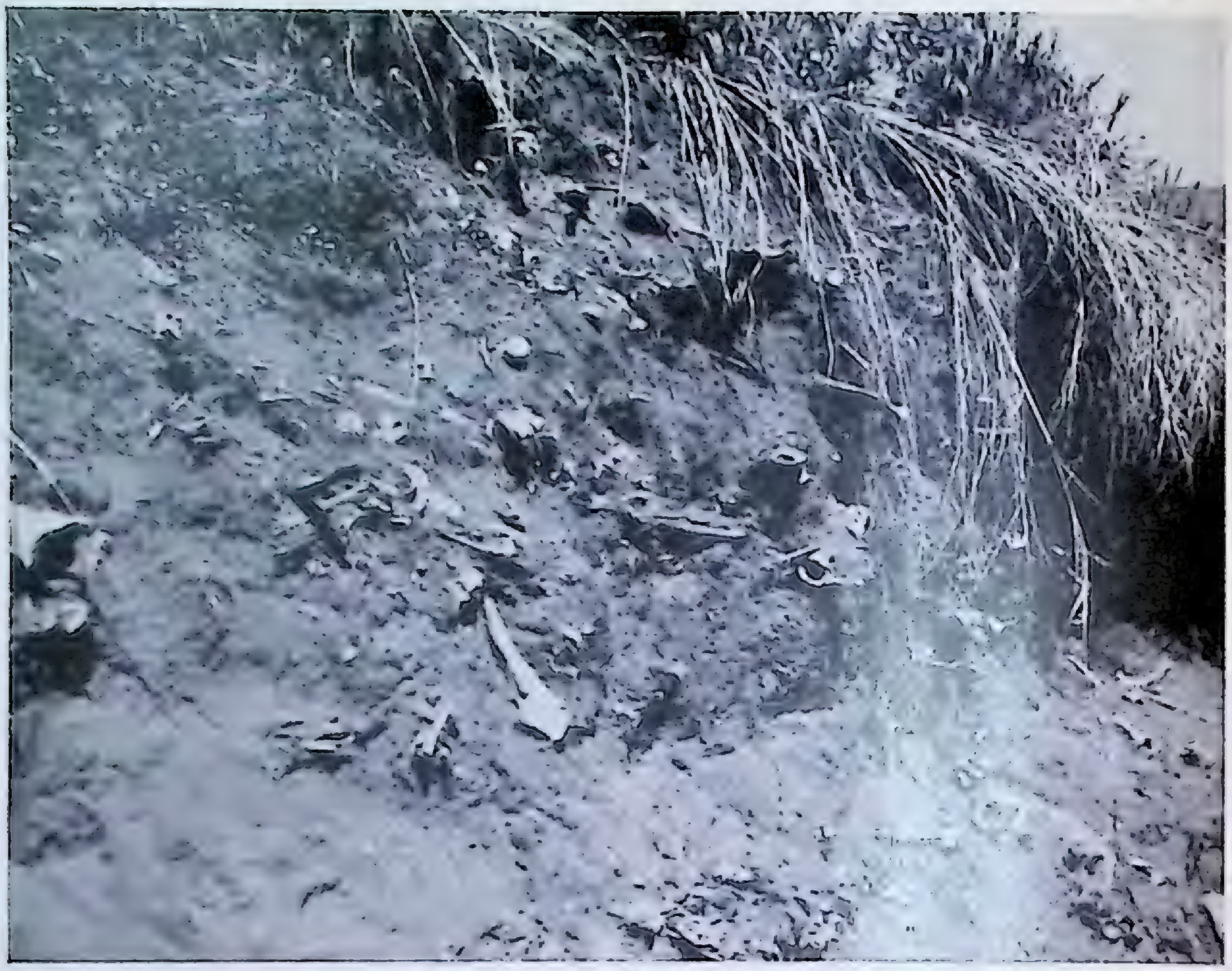
According to one version of a Blackfoot tale it was at the Old Women's Buffalo Jump that the first marriage ceremony took place. Hugh Dempsey, archivist for the Glenbow Foundation, has generously granted permission to record here his interview with the late John Cotton and Teddy Bull Shield, both of the Bloods, on January 4, 1957, Senator James Gladstone interpreting.

THE WOMEN'S BUFFALO JUMP

> "There were two places which we called Women's Buffalo Jump," said John Cotton, an 83-year-old Blood Indian. "One was north-west of Claresholm on Willow Creek, and the other was near Cayley."
>
> The buffalo jump near Cayley is thought to be one of the oldest used by the Blackfeet, as the origin of its name is told in the mythology of the tribe. It concerns a mythical character named Napi or Old Man, who was a trickster and the creator of many of nature's wonders.
>
> "In the early days of the world," said John Cotton, "the men and the women used to travel in separate camps. The men had their chief and the women had theirs."
>
> One day Napi called the men together and said: "Why should we live apart from the women? If we all live together, then we can spend our time hunting and going to war, while the women can do the cooking and tanning of hides."
>
> The men thought it was a good idea, so Napi went in search of the women. He found them near the foothills, where they all lived in a large camp. Nearby they had a buffalo jump which was their main source of food. *This was the Women's Buffalo Jump near Cayley.*
>
> Napi met the leader of the women and told her the plan. The woman chief agreed, and asked Napi to bring the men to her camp so that each woman could choose a man to be her partner.
>
> Napi returned to the men and told them the news. He had noticed many beautiful women in the camp and made plans to get the best one for himself. When the men moved to the Women's Buffalo Jump, Napi stole from the camp and, dressing himself in women's clothes, he went to the women's camp and decided which woman was the most beautiful.
>
> Before he had time to return to the men, they arrived, and the women began to choose their partners. The woman of Napi's choice saw a man she liked, but Napi intercepted her and told her to choose him. The woman, however, wanted the other man and by-passed Napi in favour of him.
>
> Napi then went to the next most beautiful woman, and the same thing happened. Finally, when all the choosing had been done, Napi was the only one without a woman. In anger, he went to the buffalo jump and changed himself into a pine tree. And there he stood, alone, for many, many years.
>
> "Maybe the lone pine tree is still there," commented Teddy Bull Shield.
>
> The earliest known reference to the Women's Buffalo Jump is in the winter-counts now in possession of Jim White Bull, a Blood Chief. The winter-counts are a calendar system used to keep a record of the years. The winter of 1842-43 was known as the year when the Bloods camped at Women's Buffalo Jump. The name was also recorded by George Dawson, in his list of Blackfoot place-names for the Geological Survey of Canada, 1881.
>
> John Cotton said that a camp of Bloods once scored a great victory over the Crows at the Women's Buffalo Jump. The Bloods, under the leadership of See-pisto or The Owl, were camped near the buffalo jump when a large war party of Crows planned to raid them. However, the Bloods discovered the Crows and waited in ambush for them. In the battle, the Crows were beaten off and suffered many casualties.
>
> The Blackfoot name for Women's Buffalo Jump is *Akee'-piskun* (*Akee*—woman; *piskun*—buffalo jump).

In a later interview with John Yellow Horn, head chief of the Peigans, Dempsey found that Yellow Horn, as a youth, had been told that the Women's Jump was near Cayley. He saw it while on the Macleod-Calgary

PLATE II



Bones in west wall of the gully cut by the flash flood. This unexcavated cutbank is across the gully from the upper pit.

trail about 1900. There was at that time a pine tree at the site (interview of April 3, 1961). According to the 1894 Blackfoot sheet, a map in the National Topographic Series, the Macleod-Calgary trail ran within three-quarters of a mile of the jump, and the jump would certainly have been visible from the trail.

Several other versions of the first marriage story have been recorded, but Cayley or Squaw Coulee is not specifically mentioned as the site. (The name Squaw Coulee in itself, however, is suggestive.) Wissler and Duvall mention no location; but they cite Lowie to the effect that the Northern Blackfeet place it on the Little Bow River, which has its head a few miles north of the jump (1908, pp. 21–22). In Uhlenbeck, the location is given as the Porcupine Hills, which begin just south of Squaw Coulee (1912, pp. 167–169); McClintock states that the women, at the time of the first marriage, were camped at a jump on the Oldman (Crow Lodge) River (1910, pp. 346-347); it is the only version, apparently, that places the marriage site at any appreciable distance from the Old Women's Jump.

So, although the evidence is inconclusive and shall probably remain so, it seems likely, from present-day informants, that the Cayley Kill is actually the Women's Jump. It has come to be known locally as the Old Women's Buffalo Jump. The adjective "old" clearly modifies jump, not women.

ACCOUNTS OF BUFFALO JUMPS

Probably the most colourful and complete eye-witness account of buffalo drives was written by Peter Fidler, of the Hudson's Bay Company, in an unpublished manuscript describing his travels in 1792–3. Through southern Alberta, he accompanied a group of Peigan (Muddy River) Indians who, although they were well accustomed to the use of the horse by that time, persisted in the practice of driving the buffalo. Fidler no doubt camped near the Old Women's Buffalo Jump, if not at the site.

Before a drive, the men held a ceremony to induce success, and the old men delivered speeches amidst much smoking. Then followed the arduous and often disappointing task of attempting to induce the herd to the kill. Fidler described it as follows:

> The Young Men sleep out all night in general—when they bring the Buffalo to the Pound—& sometimes they will bring whole herds above 40 miles off & sleep 2 or 3 night according as they can drive them in a direct manner or not towards the Pound . . . Bringing the Buffalo to the Pound, particularly when at a great distance, is a very hard job for the young men, as they are obliged to run so very much to keep the Buffalo in the proper direction for the Pound—there is a deal of Art in thus driving them the way they wish—as it is such a wild Animal—& the sight of a single person will frighten a whole herd—they will smell a person at an amazing distance when they are to the lewards of him—& if one runs, should there be thousands in the herd, they will all run . . . (entry for Dec. 28, 1792).

As the buffalo approached within a mile or two of the pound, the young men attempted to direct them between two "fences" which converged at a drop or cliff, below which the pound was located. Shifts of two men tended the fences, keeping constant watch in order to warn those at the pound of the approach of the herd. As the herd drew near, all participants assumed their assigned places very quietly and remained still, lest they startle the animals into stampeding in other than the desired direction. The tents had been pitched where the buffalo could not see them.

Although the fence was sometimes made of piles of stone or brush, one that Fidler saw consisted of 4 or 6 pieces of

> dry Buffalo dung . . . piled up about knee high & about the distance of 30 yards from each other, & at the rock the 2 sides are not more than 20 yards asunder, but they spread gradually . . . [so] that at the other end the piles of Dry Buffalo dung will be 1 or 2 miles wide. The Men drives the Buffalo within this kind of fence all the way to the rock & by the great way the Buffalo makes they are at the very brink of the precipice before they are aware of the Danger—& some men ly down flat on the ground near the Dead men [dung piles] & rise up as the Buffalo passes them & follows them with all speed, to keep them constantly on the run—was that not the case, the Buffalo by going along easily would perceive the danger & avoid it by turning upon one side or the other (entry for Dec. 5, 1792).

It is important to make a distinction here between a pound and a jump*, although thus far the above description could equally apply to either. Pounds consisted of enclosures into which the buffalo were driven live.

In general, the pound was delimited on one side by a low escarpment, often along a creek, and on the other three sides by a strong wooden fence. One pound that Fidler measured was some 50 yards long and 20 yards wide. Herds driven over the bank were trapped and killed. The Pound Master, having directed the operation,

> must go & kill the first one when after any body may kill that wishes—he generally shoots his one with a gun. The young men kill the rest with arrows—Bayonets tyed upon the end of a Pole & the Hatchet is frequently used—& it is shocking to see the poor animals thus pent up without any way of escaping—butcherd in this shocking manner—some with the stroke of an ax will open nearly the whole side of a Buffalo—& the poor animal runs some times a considerable while all thro' the pound with all its internals dragging on the ground & trode out by the others—before they dye—so soon the Buffalo gets into the Pound, they constantly keep running all round, never being a moment still, until they are all killed—when the women goes over the hedge & cuts up the Buffalo & takes the best parts—sometimes the Buffalo a fresh herd will come into the Pound while the women are thus employed, which makes them run headlong over the hedge to escape—sometimes the Indians say that a few are killed before they can get out of the Pound (entry for Dec. 28, 1792).

A jump, or fall, was a cliff or steep slope over which the buffalo were driven either to be "killed or entirely disabled from the fall," or to be so "bruised as to be easily dispatched with bow and arrow." (Coues, 1897, p. 725.) Such, no doubt, was the Old Women's Buffalo Jump; but only one of many, for as Fidler observed

> all thro' these extensive plains, several of these steep perpendicular rocks are to be seen, which the Indians never fail to make proper use off for Killing the Buffalo—they seem to have been designed by nature for that purpose where no woods are to be seen (entry for Dec. 5, 1792).

The Fidler account is probably the best of many by early explorers. Lewis and Clark mention a jump on the Missouri River, noting, as did Fidler, the incredible stench emanating from abandoned kills (Thwaites, 1904, vol. 2, pt. 1, p. 94). Alexander Henry discussed both jumps and pounds in some detail (Coues, 1897, pp. 576–7, 723–5); and Matthew Cocking appears to have been the first to describe a pound (Burpee, 1908, pp. 109–113), although neither he nor Henry actually reports seeing one in operation. DeSmet provides a thorough description of an Assiniboine pound, presumably used in the 1850's (Chittenden and Richardson, 1905, Vol. III, pp. 1025–1032). Accounts essentially ethnological rather than historical are

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*In historical and anthropological literature, buffalo kills are known by a wide variety of names. I would regard the term "kill" as generic; and the Blackfoot word *piskun*—"deep blood-kettle" according to Grinnell (1892a, p. 228)—is equally equivocal. "Drive" and "trap," too, could be applied to either a jump or a pound. "Jump" seems least ambiguous in denoting such sites as the Old Women's site, where buffalo were driven over a cliff to their death, although the term "fall" is equally graphic. Terms like "pound," "corral," and "pen," obviously refer to kills in which animals were fenced in; whereas other terms—"park" and "quarry"—provide no specific indication of the kind of kill.

to be found in Wissler (1910, pp. 33–38), Grinnell (1892a, pp. 228–234; 1892b, pp. 127–134), Lowie (1909, pp. 10–12; 1954, pp. 13–15), Ewers (1949, pp. 355–360), and Gilmore (1924, pp. 204–211). Archaeological publications on buffalo drives are few and of limited value. The most complete deals with two sites near Livingstone, Montana (Brown, 1932, pp. 75–82); and Shumate has discussed some kills around Great Falls, Montana (1950, pp. 4–9). H. P. Lewis compiled an extensive work on buffalo jumps in a manuscript that has achieved fairly wide circulation among specialists, even though it has never been printed. Other scattered references, some listed in the bibliography, briefly mention buffalo kills.

Distribution and Age of Buffalo Jumps

Wissler's comparative notes show that many tribes other than the Blackfoot obtained their winter supply of meat by driving buffalo (1910, pp. 33–8, 42–52). Pounds were used by the Plains Cree, the Assiniboine, the Siksika; and, as Cocking found in 1772, by the Archithinue, now known as Atsina (Burpee, 1908, p. 109). Driving the animals over a cliff, with or without a corral below, was largely practised by the Peigan, Blood, Arapaho, Gros Ventre (Atsina), Kutenai, and probably by the Hidatsa and Crow. Grinnell states that "before the Indians of the northern plains obtained horses, they all of them secured most of their buffalo by means of traps and surrounds . . ." and though he does not specify whether they pounded the buffalo or drove them over a cliff, he found from his own inquiries that the following tribes used the surround: Cheyenne, Arapaho, Mandan, Snake, Cree, Hidatsa, Blackfoot, Sarsi, and Atsina (1892b, pp. 132–3). Teit was informed that the Flathead and Cœur d'Alene once stampeded buffalo over cliffs (1930, pp. 103, 347). Brown implies that one of the drive sites near Livingstone, Montana, could be attributed to the Shoshone (1932, p. 81), because of a steatite vessel found there.

The archaeological distribution of buffalo drives corresponds closely with the location of these tribes in historic times. Drive sites are common in southern Alberta, extending through the plains of southern Canada well into Manitoba, where MacNeish partially excavated a site near Brandon in conjunction with the Stott Mound (1958, p. 65). In the United States, they are particularly abundant in the plains and foothills of Montana. They are said to occur in the intermontane basins of western Montana and British Columbia. They extend into the western Dakotas (Wedel, 1948, p. 49). How far south they go is still problematic, but they seem relatively plentiful in Wyoming; at least two are known in the parklands of northern Colorado (J. B. Wheat, pers. comm.). Wissler mentions the occurrence of drive sites between the Platte and Arkansas rivers, without giving specific locations (1910, pp. 47–50). One would suspect them to be near the mountains, in Colorado. And Hibben has excavated a jump, apparently representing a single kill on Corrumpa Creek, in northeastern New Mexico, near Des Moines (pers. comm., Jan. 5, 1961).

The antiquity of buffalo jumps and pounds remains in question. It seems likely that some method similar, if perhaps not identical, to the jumping of buffalo was employed in the Paleo-Indian period; Wheat has postulated that buffalo were driven into an arroyo at the Olsen-Chubbock site (Report at the 18th Plains Archaeological Conference, 1960). Numerous Scottsbluff points indicate an age of about 7,000 or 8,000 years ago for that site.

Mulloy places the lower level of his Billings Bison Trap in the Late Middle Prehistoric period, estimated at A.D. 0 to 500 (1958, pp. 142–7, 222); and Wettlaufer conservatively estimated the earliest occupation of the Ft. Macleod, Alberta, jump at 3,000 years before the present (letter from Wettlaufer to Hugh Dempsey, June, 1959). A radiocarbon determination for one of the lower layers of the Old Women's Buffalo Jump is 1840±70 years ago, which would be in line with Mulloy's estimate but younger than Wettlaufer's.

As for the terminal date, although Grinnell is no doubt generally correct in his statement that the driving of buffalo was supplanted in historic times by running them with horses (1892b, pp. 132–3), it is equally clear that some tribes, especially those poor in horses, persisted in the use of drives until the buffalo were virtually exterminated in the early 1880's. Most of these tribes were located in Canada. Ewers has shown that the Northern Blackfeet ceased to impound animals only because the herds vanished (1949, p. 360). The same situation seems to be true of the Plains Cree and Assiniboine.

Driving buffalo over a cliff, as at the Old Women's Jump, was abandoned even earlier than impounding. Apparently no white man was ever eye-witness to report a jump in operation; although as late as 1892, Grinnell stated that *piskuns* were in use among the Blackfoot 30 years ago (1892b, p. 132); they are said to have been used by the Bloods until 1869 or 1870 (John Cotton to Hugh Dempsey, June 3, 1956). Some of these *piskuns* may have been jumps but were more likely pounds. Trade goods are extremely rare at jump sites, and, when they are found, they are not necessarily in association with the jump itself. A possible exception is the site at St. Peter's Mission, in Montana, where copper projectile points were found (Shumate, 1950, p. 7).

But generally speaking, it would appear that jumps were most common in the areas later occupied by tribes with large numbers of horses and that running the buffalo with horses quickly supplanted the practice of driving them over cliffs. The areas in which pounds continued to be used were the same areas occupied well into historic times by tribes relatively poor in horses.

Climate and Topography

In Alberta, climate and topography largely dictated the circumstances for a successful buffalo jump. Native vegetation consisted of tough, drought-adapted grasses which could survive in a semi-arid climate where precipitation ranges from 14 to 16 inches a year, and where relatively cold, continental conditions prevail. These grasses formed the staff of life for grazing animals, particularly buffalo and antelope, which in former times blackened the Plains with their numbers. Deer, bear, and elk frequented the timbered valley bottoms. Even carnivores, especially the wolf, depended indirectly on the nutritious grasses of the Plains.

In this land, the prevailing wind comes from the southwest. During the winter, it often brings the chinook from west of the Rockies, and this blast of warm air can release the adjoining Plains from the grip of winter within a matter of hours. At present, as in prehistoric times, this region seems to have been an especially favoured pasture for grazing animals when much of the Plains to the east was locked under a blanket of snow. It is likely, for the same reason, that the native peoples preferred to have their winter camps in the strip of Plains where the chinook exerted its maximum effect.

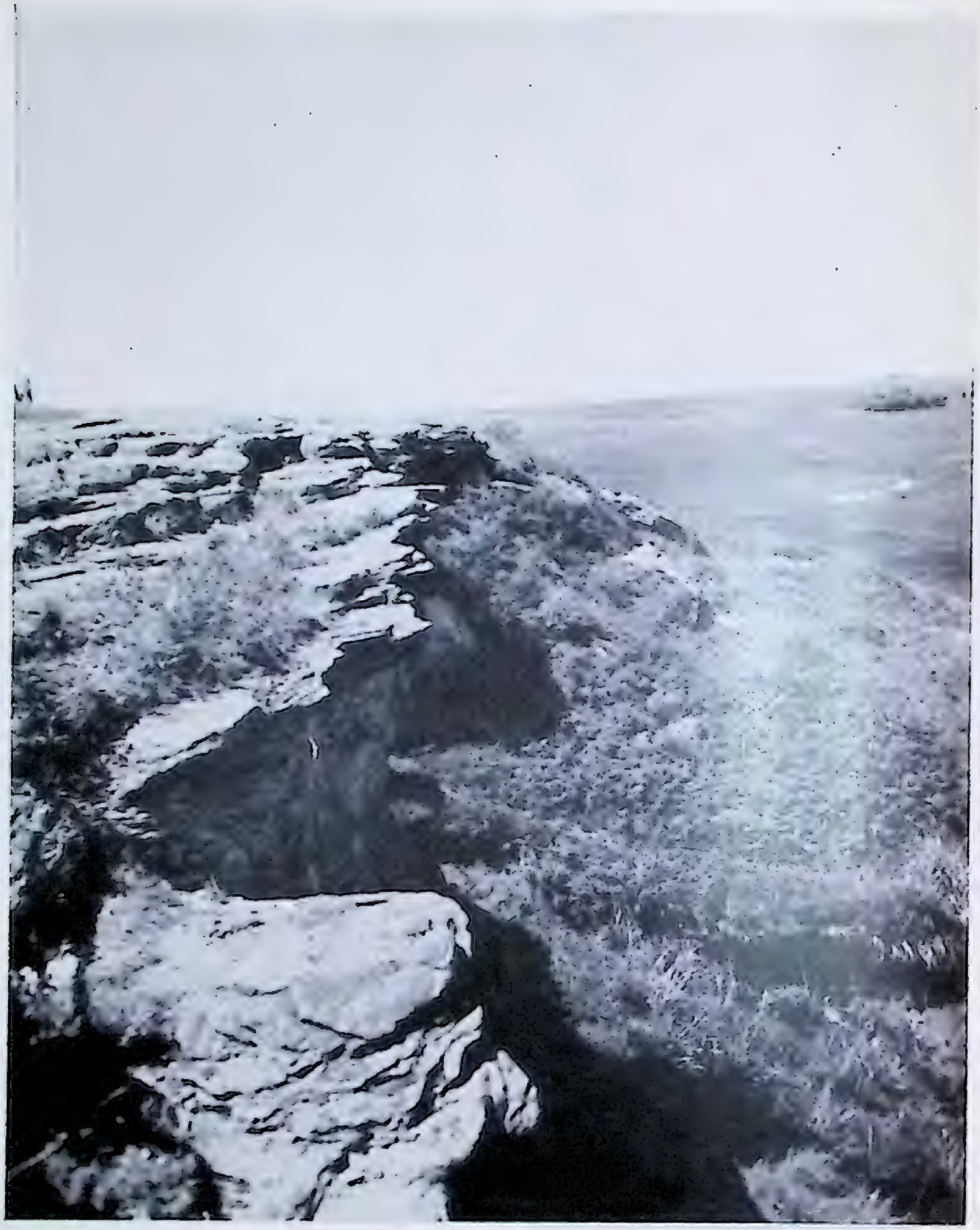
The direction of the wind was closely tied into the topographic situation. In most jumps, the buffalo were driven from the west or southwest over cliffs facing east or north. H. P. Lewis, in his manuscript on *Buffalo Kills in Montana,* explained the direction by the fact that the winds come from the southwest. He held that hunters driving the buffalo toward a cliff would find it advantageous to steer them in that direction by allowing themselves, at appropriate times, to be smelled. Then, too, driving the buffalo with the wind rather than against it prevented the animals from scenting the stench which often emanated from a much-used kill.

Topographically, the ideal country for a jump is broken with steep slopes and sharp drops over rock cliffs. Such is the country of the foothills, where streams and rivers have cut deeply into the land. Other kinds of kills—pounds and ambushes—become increasingly more common on the level prairies to the east, for they place no exorbitant demands on landforms.

Two essential components of a successful jump are the gathering basin and the cliff. The gathering basin, as H. P. Lewis has called it, is the pasture on the prairie level where buffalo would tend to graze. Presumably, at the most frequently used jumps, the gathering basin was circumscribed by certain natural features which induced the buffalo to drift toward the trap. These features were often augmented by the construction of a pair of "wings," 1 or 2 miles long, which served to funnel the herd toward the cliff. The wings consisted of small piles of stone, dung, branches, or other materials set in a row and spaced about 20 or 30 feet apart. The Sloane brothers do not recall whether wings were present above the Old Women's Jump before the land was broken. Sometimes the land between the fences was cleared of obstructions to induce the buffalo to remain between them.

The drop was preferably in such a location that it was not evident to the buffalo as they approached it, at least not until they were running so fast that they could not veer away from it. It could vary greatly in height, from a few feet to several hundred feet. Probably most cliffs were between 20 and 50 feet, but the drop had to be sufficient to kill or maim the animals, for in the treeless country where jumps are most common, a pound was built at great expense. Most of the cliffs faced east or north, largely because of the direction of the prevailing wind; and also, possibly, because of the protection the cliff would afford against the rays of the sun, thus preventing the meat from spoiling as rapidly as it might if exposed to the sun. It is perhaps significant that those known sites which face to the south are poor in bone and artifact content and do not seem to have been used often or intensively.

Generally, the camp-site, which is almost uniformly associated with a buffalo jump, is to be found in the bottom of a coulee or valley. There a spring or stream provides the water that is essential to food and hide



Looking west along the cliffs at the Old Women's Jump. The base of the cliff is full of nooks and crannies. The cliffs are of Paskapoo sandstone, which is easily eroded, and many large blocks and pieces of it were struck during excavation.

preparation. The slopes of the valley give the camp some protection from cold winter winds; they also permit the camp to be hidden from the sight of buffalo that would not approach a settlement of man, and thus would not approach a nearby jump.

SIGNIFICANCE OF BUFFALO JUMPS

Although buffalo kills have not been entirely slighted in historical and anthropological writings, their place in aboriginal life has neither been fully appreciated nor emphasized.

On the Northern Plains, wherever flora, fauna, climate, and topography combined in almost the correct degrees, buffalo kills provided the principal means of winter subsistence to many, if not all, of the tribes before the acquisition of horses. Perhaps the critical word is "winter," for it was during that season that life was most difficult, a circumstance that would largely limit the numbers of foot-nomads capable of year-round occupation. With the horse, which first appeared between A.D. 1700 and 1750, methods of hunting changed; and though the practice of driving the buffalo was then largely forsaken, it is by no means certain that this practice produced a less abundant livelihood.

If, owing to the efficacy of buffalo drives, the plains were an attractive area for native settlement, the implications may be far-reaching. Is it true, for instance, that the area was largely a great vacuum in prehistoric times, filled only when tribes living in more "favourable" areas to the east were forced into it? Not long ago, it was thought to be (Kroeber, 1948, p. 823); but this notion now has to be abandoned in the light of overwhelming archaeological evidence. No doubt, much of the intensity of Plains occupation was a result of the success of the buffalo drive.

That forest dwellers, such as the Cheyenne, made their way in early historic times onto the plains, forced by population pressure from the east, is hardly in doubt (Strong, 1940, p. 391). It is a mistake, however, to assume that they necessarily abandoned a particularly desirable region for one less attractive. Malin has deplored the habit of scholars to assume that "the presence of forests was natural and the absence of them was an unmistakable sign of deficiency, an abnormality of nature" (1948, p. 2). This, apparently, was the kind of thinking that led to the belief in an uninhabitable plains in prehistoric times. Buffalo jumps provide one solution to the problem of making a living on the plains in the "dog days."

Native horticulture was not so bounteous that it tied men to the land. There is every reason to believe that the Crow, at least, preferred buffalo hunting to a semi-horticultural existence. Some authorities place the Crow-Hidatsa split at about 1775; others place it well back into prehistoric times. In any case, it seems likely that the Crow moved onto the plains out of sheer preference for it. This preference was almost certainly acted upon again and again by other tribes now veiled in prehistory. With buffalo drives, many could make a good living.

Certain facets of native life on the plains probably had ancient roots. If the plains offered its vast herds of buffalo, and an effective means to secure them, it must have presented a strong lure to peoples who were wholly or partially dependent on hunting. Most likely, upon attempting to immigrate, they met a hostile reception. Intruders would have had to fight for their place; the Plains militarism, so characteristic of historic times, was probably an ancient trait, not one developed in the period of cultural change after the coming of the horse.

And it would be a mistake to assume that other aspects of Plains culture, as they are known from historical accounts, emerged full-blown without prehistoric antecedents. One of the unfortunate limitations of archaeology is that it can rarely provide more than inferential evidence on social and religious life in prehistoric times. Much of the material culture, also, is so perishable that it remains unknown. But if archaeology in the Northern Plains cannot positively illuminate all aspects of culture, it does suggest that some elements of culture persisted for great lengths of time into the historic period.

Those peoples living on the Plains before the horse were culturally adapted to the environment, just as those tribes of historic times were adjusted to the opportunities and limitations of the Plains. It seems reasonable to think of the Plains, even in prehistoric times, as a culture area, upon which the horse and gun were merely superimposed. The early bearers of this culture, as well as the late ones, relied primarily on buffalo for food, and most other traits of their material life centred around this animal. At least since the time of Christ, they depended heavily on the practice of driving the buffalo into pounds or over jumps; this practice seems largely accountable for the fairly intensive occupations of the Plains in prehistoric times.

SIGNIFICANCE OF THE OLD WOMEN'S BUFFALO JUMP

The Old Women's Buffalo Jump is a superb representative of a type of site which is widespread throughout the western part of the Northern Plains. Happily, it escaped destruction by the "bone pickers" who sold their product on a commercial basis. Excavations in the undisturbed deposits revealed that the site was used continually and intensively for a period of over 1,500 years. The site yielded an excellent sample of projectile points for statistical analysis. The relevant results of this analysis are reported below.

In view of its associations in the mythology of Blackfoot-speaking peoples, the Women's Jump was almost certainly a Blackfoot site, at least in the most recent period. How far into the remote past can it be thought of as Blackfoot? It did yield pottery, in Layer 5, which is highly similar to that from the Ross Site, on the Oldman River, also considered to be Blackfoot (Forbis, 1960, p. 164; Kehoe, 1959, p. 244). It is only fair to note, however, that many reputable scholars do not accept this view (esp. John C. Ewers, pers. comm.). Basing their conclusions largely on traditions and legends, they maintain that the Blackfoot are recent immigrants to the area, almost in historic times, rather than as early, possibly, as A.D. 1400 or 1500.

There are other complicating factors in attributing the site to the Blackfoot in remote times. First, "Blackfoot" is a term referring primarily to peoples speaking the same language. Culturally, they are not vastly different from their neighbours on the plains. As all languages change slowly through time, the Blackfoot language of prehistoric times must continuously diverge from that of historic times; increasingly so, through Proto-Blackfoot, until it would be classified as Algonkian, not Blackfoot. At what point it ceases to be Blackfoot, or even Proto-Blackfoot, is a question for the linguist.

Secondly, it seems highly probable that the variations in projectile point types at the Old Women's Jump reflect similar changes over a large area. The types may fall into "horizon styles" in use among widely scattered peoples. Indeed, this conjecture seems highly probable in view of the widespread distribution of the types beyond tribal boundaries. If the points do distinguish horizons, the sequence developed below for the Old Women's Jump will have chronological application over a large area. But at the same time, this means that unless projectile points are found in contexts with artifacts diagnostic of a specific group of people, they cannot be used in attributing any site to the Blackfoot or to any other tribe.

EXCAVATIONS AT THE OLD WOMEN'S BUFFALO JUMP

METHODS

Upper Pit

In 1958, the area of contemplated excavation, in the heart of the bone deposit, was laid out in a grid of five-foot squares. North-south lines were designated by letters and east-west lines by numbers (Figure 3). The squares took the letter-number designation of the lines intersecting at their southeast (uphill) corners. In the beginning, the "A" squares were the most easterly; the "C" squares at the west end of the trench were cut short by the gully dissecting the bone deposit. As excavations passed beyond the testing phase, squares designated "D" to "I" were added, the "D" squares adjoining the "A" squares, and the "I" squares then being the most easterly. The zero line, running east-west, delimited the southern edge of the trench; the "5" and "10" (foot) lines paralleled it down-hill to the north.

For the most part, each unit was excavated in natural layers rather than arbitrary levels. The method of excavating by layers proved to be impracticable in the two most easterly squares ("H" and "I") and in an unproductive test pit on the west side of the gully (Unit "XY"), since most of the upper layers merged into a homogeneous mass of considerable thickness. There, arbitrary levels were six inches thick. The natural layers, of course, varied in thickness, but in general could be said to range from eight to ten inches.

Almost exclusively, shovels were used for digging; the dirt was sieved through a screen of quarter-inch mesh except in the water-saturated lower layers. There the earth was allowed to dry on plywood tables and was carefully trowelled for artifacts. To a depth of six feet, it was practical to throw the dirt to the surface for screening; some advantage was gained near the gully by lowering the screen into the gully to a position where it could still be reached by shovel. This method served to a depth of about twelve feet from the surface, when buckets on ropes had to be brought into service with a resultant slowing down of the operation.

To facilitate excavation, King developed a swivel sweep. A long, sturdy lever was attached at the fulcrum to one of the vertical beams, earlier set in place to prevent the slumping of the uphill wall of the trench (Plate IV). A universal joint allowed the pole to swing from side to side as well as up and down. A bucket was attached to a hook on a

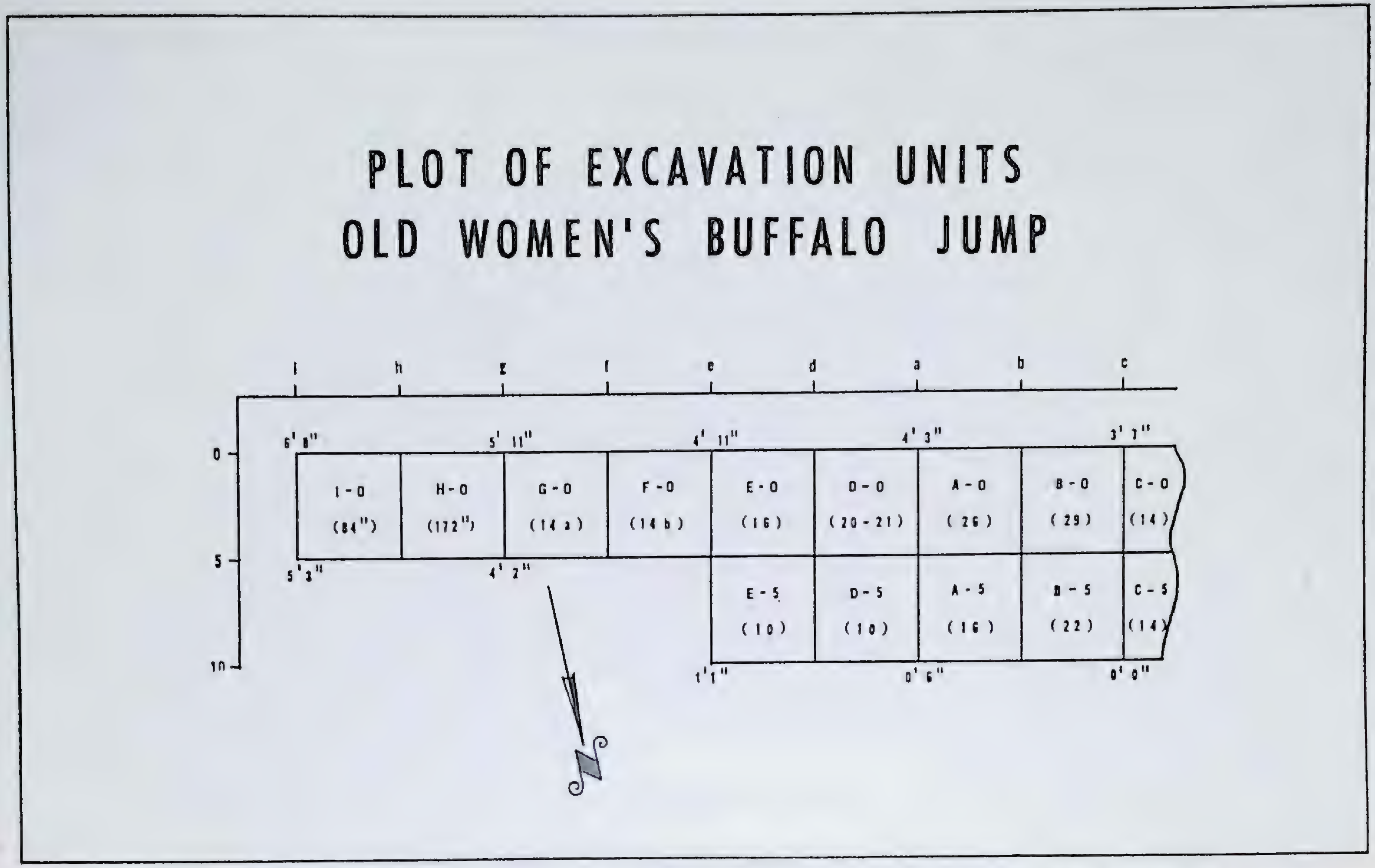
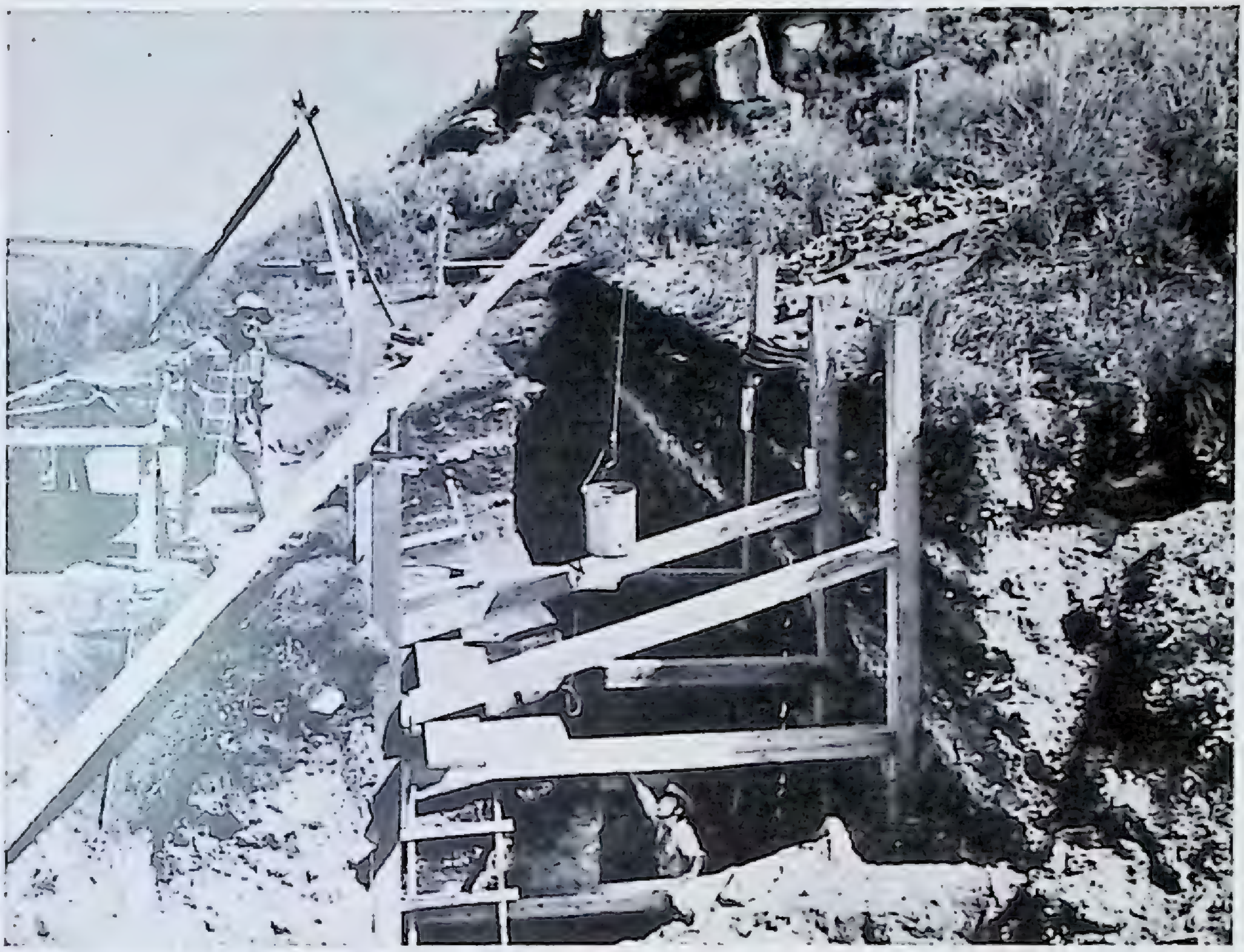


FIGURE 3. Diagram showing locations of excavation units in the upper pit, and showing elevation of certain points in relation to stake C-10. The units are 5 feet square. Figures in parentheses indicate lowest layer excavated in a given square (except H-0 and I-0, where depth is given in inches below the surface).

rope hanging from one end of the pole. A rope at the other end of the pole provided a grasp for the man charged with lifting the bucket. The chief advantage of the sweep was that it allowed the hauling of goodly amounts of dirt (and, later, of water) with greater speed and less effort than before, and without damaging the walls of the trench.

PLATE IV



Excavations in the upper pit. Note the white ash beds (Layers 4 and 10). Buckets hoisted by the swivel sweep were used to lift water and soils from the lower layers.

As indicated, once the testing phase was passed, the trench was extended to the east. The most easterly square (I–0) is only a few feet from the sandstone outcrop that partially encircles the bone deposit in all directions but the north. It was hoped that in the eastern squares the layers which had already been distinguished in the west would be shallower and that the water which had forced a halt to excavations in square B–0 might not be present. These hopes proved vain. Many layers merged into a mass with no observable stratigraphic separation, and some layers expanded so that the bottom of the deposit at ground water was still of great depth (about 14 feet below the surface).

The eastern squares proved disadvantageous in other ways. While certain of the upper layers could be traced from the west (until they merged into a homogeneous mass), large boulders of sandstone between the western and eastern squares prevented accurate correlation of the lower layers.

(Some of these large boulders were removed in the western squares by sledge hammer and star drill, a laborious and time-consuming process.) Archaeologically, a direct correlation of the east and west lower layers proved unnecessary because of the total absence of diagnostic artifacts in the eastern squares (H–0 and I–0). Even the upper layers proved to be much less rewarding in artifacts.

Lower Pit

In 1959, excavations were resumed at the jump, with the dual objects, (1) of securing an independent sample of specimens sufficient to indicate whether or not the typological sequence developed for the uppér pit was valid, and (2) of determining whether or not the excavations of the previous year had reached the lowest occupation layer.

The lower pit was laid out about 40 feet downhill from the upper pit and on the same grid. The squares were numbered accordingly. Actual procedures varied little from those described for the upper pit. Units were dug by layer rather than level. The layers were numbered, starting at the top with "1" and continuing through "16," which was of the same yellow clay that occurred at the bottom of the upper pit, and formed what appears to represent a sterile base to the cultural layers.

As the stratigraphy in the upper pit obviously differed from that in the lower pit, cuts were made at intervals along the gully in an attempt to correlate the two. These cuts were limited in depth to layers corresponding to Layer 14 of the upper pit.

A fourth, final, excavation, completed in 1959, took place on a cutbank of the gully just uphill from the upper pit. Excavations in Unit "P" were designed to recover more artifacts from Layers 6 to 14, in order to augment the sample from the upper pit; as this attempt was not markedly successful, the artifact count is less than is desirable.

PHYSICAL STRATIGRAPHY

Upper Pit (Plate IV)

Two major divisions in the bone deposit at the Old Women's Buffalo Jump have been devised for convenience in denoting the nature of the cultural remains. The *upper member* runs from the surface down to Layer 14; the vast majority of the artifacts from it are small projectile points, usually side-notched and presumably arrowpoints. The *lower member* comprises Layers 15 to 30; most of the points in it are comparatively large and heavy. They may be dart points.

In a general way, the two members are distinct in physical as well as cultural features. The stratified layers of the upper member are composed mainly of bone, either burned or unburned, suggesting much more intensive use of the jump than the lower member. The lower member is composed principally of soil layers distinguished from each other by texture and colour.

As described below, the component layers are best represented in the west part of the trench (Figure 4), for, as noted elsewhere, there is much merging toward the east.

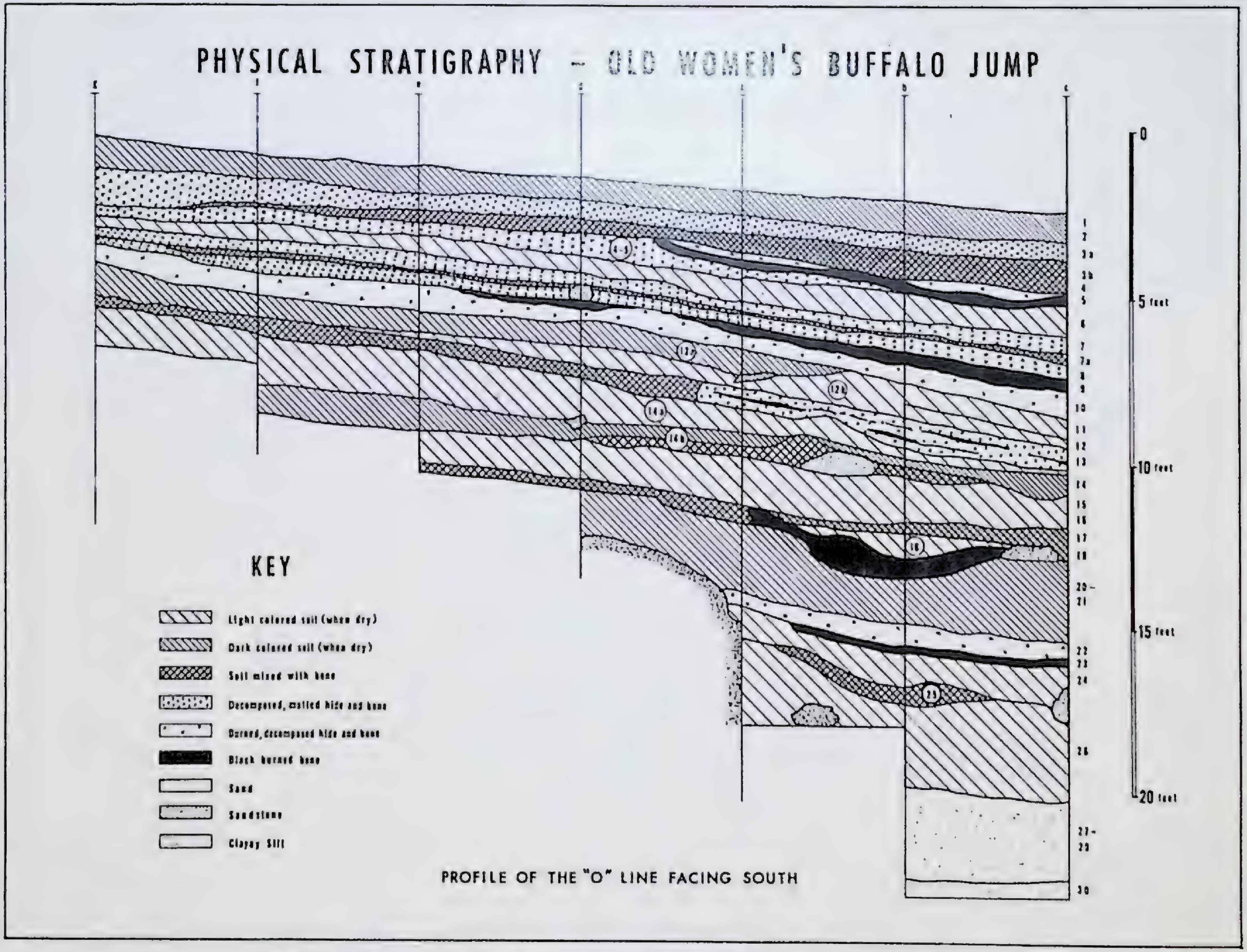

PHYSICAL STRATIGRAPHY – OLD WOMEN'S BUFFALO JUMP
1
2
3a
3b
4
5
6
7
7a
8
9
10
11
12
13
14
15
16
17
18
20-
21
22
23
24
26
27-
29
30
0
5 feet
10 feet
15 feet
20 feet
KEY
▨ Light colored soil (when dry)
▨ Dark colored soil (when dry)
▩ Soil mixed with bone
▒ Decomposed, matted hide and bone
☐ Burned, decomposed hide and bone
■ Black burned bone
☐ Sand
☐ Sandstone
☐ Clayey Silt
PROFILE OF THE "O" LINE FACING SOUTH

Figure 4. Profile of the stratigraphy of the south wall, upper pit.

UPPER MEMBER (1-14b)

(1–2) Humus (sod) and subhumus. Predominantly drift soil from the prairie level. According to Wm. Odynsky (pers. comm.) there is a weak development of a soil profile, the only one at the jump. Small amounts of fragmented bone (mainly at the bottom) and small pieces of sandstone generally not more than one inch across.

(3a) Rusty-red bone layer. Bone, hide, and hair are heavily decomposed and matted to resemble peat. Many articulated bones. Some large chunks of sandstone (up to 10″ across) and many small fragments.

(3b) Bone and soil zone, probably a continuation of (3a). Reddish-grey in colour. More distinct on south face than on north.

(4) White layer of burned bone ash in the western part of the cut; almost identical to (3a) where not burned. Where burned, the bones are in very small fragments; but complete bones can be traced *in situ*.

(5) Dusty, black layer of bone mixed with loose sand. The colour is probably a result of incomplete oxidation. The layer is relatively thin and uneven.

(6) Grey drift soil showing no evidence of a soil profile. Short dark streaks are present. Variable in thickness, it has very few bone and sandstone fragments.

(7) Rusty-brown, matted bone layer resembling peat, much like Layer (3a). Both contain many pupal cases. Soil increasingly more abundant at the bottom. Contains few sandstone fragments, but some are large (12″ across).

(8) Brownish-grey drift soil, identical in composition to (6), but lighter in colour.

(9) Layer of grey and black charred bone fragments, thin, discontinuous, and uneven.

(10) White layer of burned bone, all fragmented. Like Layer (4), evidence of burning ceases toward the east end of the trench where the layer is then peaty. Lower section is black, presumably because burned in reducing atmosphere.

(11–12) Compact dark silt containing many fragments of sandstone and a few larger pieces (up to 10″ in diameter). This layer turns slightly darker toward the bottom and toward the east.

(13) Reddish-brown bone layer of peaty consistency, thicker at the west end than at the east. Contains some fairly large pieces of sandstone (up to 12″ across), but few small fragments.

(14a) Medium-grey sandy silt containing many small pieces of sandstone and some fragments of bone. Thickens from about 6 inches in the west to over 3 feet in the east. Merges with (14b) and resembles Layer 11–12. End of excavation in square G-0.

(14b) A sandy silt containing abundant bone material. Intermittent, it almost merges with (13) at the west end of the trench. Some large sandstone fragments (up to 24″ across). End of excavation in squares C-0, C-5, and F-0.

LOWER MEMBER (15–30)

(15–16) Light silty sand with a banded appearance, although intermittent. Contains an abundance of very small pieces of sandstone but little bone. Some large sandstone boulders appear to rest on this layer at the east end. End of excavation in squares A-5 and E-0.

(17) Dark, burned layer containing some sand pockets. Bones fragmented by fire, but evidence of burning ceases at about 15 feet from the west end and toward the north wall. Resembles Layer (5). Contains some sandstone slabs.

(18) Lens of silt limited to the junction of the A-0 and B-0 squares. Contains many small pieces of sandstone. May represent stream channel.

(19) Dark sandy zone with some burned areas, much like, and may be the same as, (17); separated possibly only by stream action of Layer (18).

(20-21) Rich, compact, dark-brown silt containing isolated pieces of burned bone and sandstone. Moist, it feels like gumbo. End of excavation in square D–0.

(22) Bright orange, burned layer. Many fragmentary burned bones are white; and there are many pieces of sandstone. Pinches out to the east and north. End of excavation in B-5.

(23) A black, burned layer perhaps actually the unoxidized portion of (22). Thin (about 2 inches) it contains much sandstone, but all pieces are small. Resembles Layer (5).

(24) Possibly a unit with (25) and (26), it is a grey sandy soil, saturated, and with many small pieces of decomposed bone and sandstone.

(25) Black layer of sandy silt containing some heavily burned pieces of bone. Possibly it is on this layer that many large sandstone boulders rest, or possibly on Layer (26).

(26) Grey silt containing fewer bones than (25). Many small pieces of rotten sandstone as well as larger chunks. Watery, much of the bone is well preserved. End of excavation in square A-0.

(27-29) Light sand with intermittent streaks of clayey silt. Water flows freely in the sand, and there are orange streaks running through it. It contains small fragments of scattered bone. End of excavation in square B-0.

(30) A fine yellow silt, almost a clay. Impervious, it seems to form a floor for ground water and for the cultural deposits.

Although the kill obviously served its purpose repeatedly, as shown by the stratification, it is impossible to determine how many drives took place at the site. Each layer, even those now sterile of bone, could represent any number of separate drives; the quantity of bones remaining in place was probably only a matter of how much meat was left by the Indians in excess of what could be utilized at the time.

Much speculation has arisen concerning the causes of burning of some layers. The results of burning take two forms. In both, the bone is generally charred and fragmented. (a) In one case, the resultant ash is white and floury. The colour suggests an oxidizing atmosphere. In the second, the soil is black and often greasy. It probably burned in a reducing atmosphere, lacking sufficient oxygen for total combustion.

The burned layers originally consisted of decomposed hair, hide, and bones of the buffalo. This material strongly resembles peat and burns with a punky flame. It seems probable that a grass fire could ignite the material and that, once ignited, it would continue to burn, although not in places where it was mixed with so much soil that the flame was smothered.

Whether the decomposed deposits were consciously fired by the Indians remains problematical. Certainly there was a considerable stench near a buffalo jump after the meat had begun to spoil. Sometimes the Indians left if the stench reached the camp (Fidler, Journal, entry for Jan. 14, 1793). It seems doubtful that decaying meat would burn; by the time the meat had spoiled sufficiently to burn, it probably did not produce an offensive odour.

It is doubtful that the Indians fired the deposits for reasons of sanitation; it is most unlikely that they did it so that the buffalo would not smell the jump and avoid it. The buffalo were preferably driven into the jump with the wind rather than against it. Finally, it seems improbable that the burning resulted from fire escaping a man-made fireplace. Household activities were almost certainly restricted to the camp area below the jump, and the camps were usually occupied during the winter.

H. P. Lewis, who gave much thought to the matter, satisfied himself that burning was the result of natural causes (MS. Chapter III). His conclusion on the subject seems to be the most reasonable.

Lower Pit (Plate V)

Many of the layers obvious in the upper pit merged in the lower pit. They also tended to be shallower, with the result that the cultural deposits in the lower pit were only about half as deep. The deposits were of the same general nature (Figure 5).

PLATE V

The lower pit before it was backfilled. The ladder rests on one of the lowest occupation zones in the pit. The strata are more uniform in composition than they are in the upper pit.

UPPER MEMBER (1 to 8)

(1) Dark-coloured humus and subhumus, about one foot thick. Abundant bone, sometimes with stratified appearance.

(2) Burned bone layer of limited extent, containing pockets of white ash.

(3) Peaty layer consisting of decomposed and matted hair, hide, and bones.

(4) White ash layer impregnated with loose yellow sand. Includes streaks of black burned bone, hair, and hide.

(5) Black burned zone, heavily mixed toward the east with soil which probably inhibited burning. Includes underlying layer of black, greasy (burned ?) soil.

(6) Light-coloured sandy soil with small amounts of bone.

(7) Similar soil mixed with rotten bones which decrease in number toward the east, where layer merges with (6) and (8).

(8) Light-coloured soil with chunks of sandstone.

LOWER MEMBER (9 to 16)

(9) Light-coloured soil, dark when wet, but frequently indistinguishable from (8) when dry.

(10) Light-coloured soil with heavy concentration of bone.

(11) Light-coloured sandy soil.

(12) Light-coloured sandy soil mixed with well-preserved bone.

(13) Very light coloured sand.

(14) Sand with specks of silt and some bone chips.

(15) Sand streaked with bands of silt.

(16) Fine yellow basal silts.

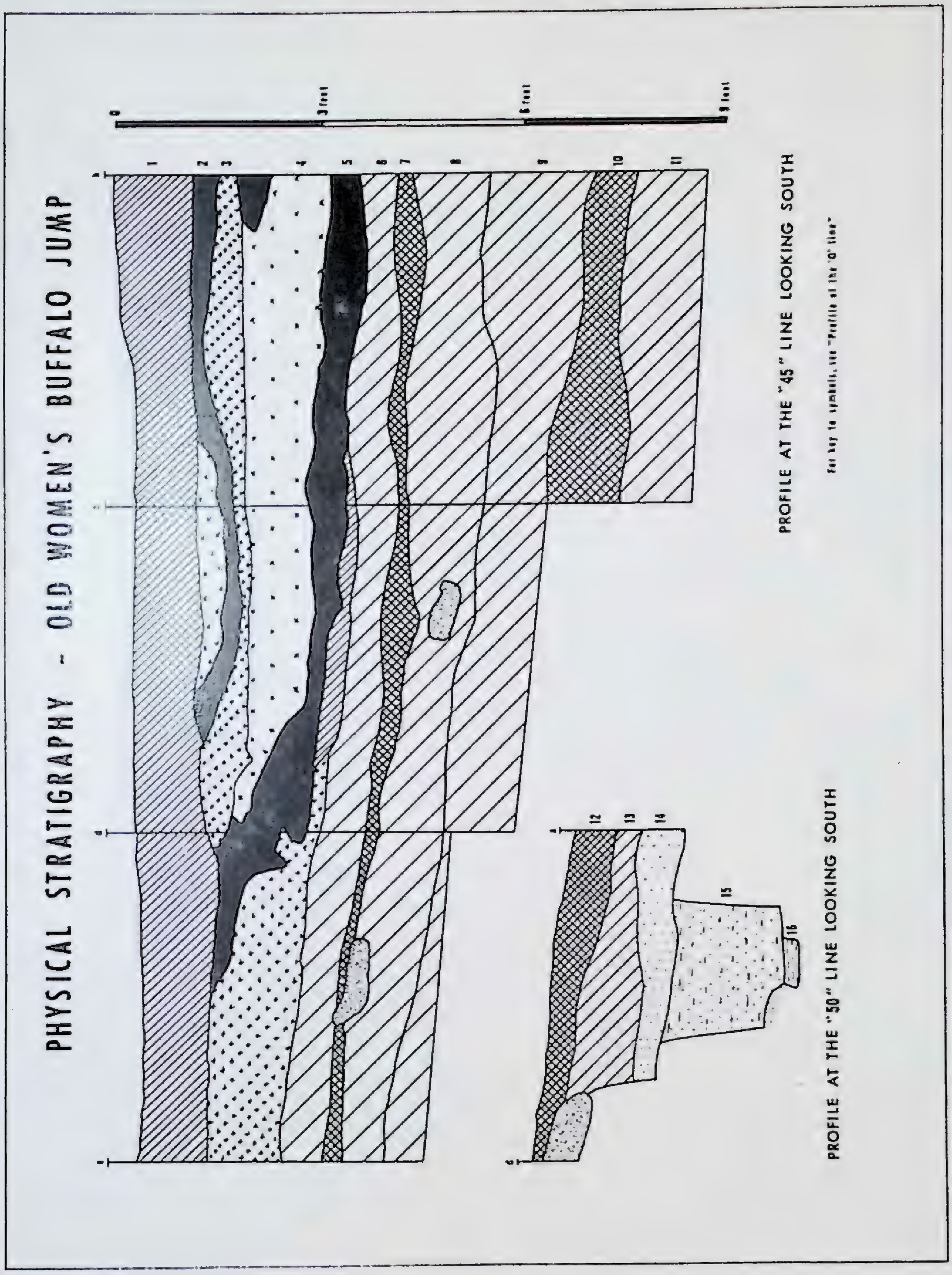

PHYSICAL STRATIGRAPHY - OLD WOMEN'S BUFFALO JUMP
0
3 feet
6 feet
9 feet
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
PROFILE AT THE "45" LINE LOOKING SOUTH
For key to symbols, see "Profile at the '0' line"
PROFILE AT THE "50" LINE LOOKING SOUTH

Figure 5. Profile of the stratigraphy of the south wall, lower pit.

Stratigraphic Correlations

By following along the cutbank, it was possible to correlate equivalent layers in the upper and lower pits to the depth of the lowest layer of the upper member.

Stratigraphic Relationships

Lower Pit Layer	Upper Pit Layer
1–2	1–2 and top of 3
3	Bottom of 3
4	Top of 4–10
5	Bottom of 4–10
6	11–12
7	13
8	14

As there is no clear distinction between the soils of Layers 8 and 9 in the lower pit, it is impossible to state on this basis whether they are both equivalent to Layer 14 of the upper pit. However, since the majority of points from Layer 9 (lower pit) are typical of the lower member, and since the lower member is defined by the projectile points that it contains, it would appear that the division between Layers 8 and 9 is a real one, and that Layer 8 is the correlate of Layer 14 in the upper pit, Layer 9 being earlier.

CONSIDERATIONS ON CLIMATIC CHANGE

Mr. William Odynsky, of the Research Council of Alberta, analysed several soil samples from different strata in the upper pit, in the hope of ascertaining the age and climatic conditions prevailing at the time that the various strata were laid down.

The soils between the main bone layers were relatively homogeneous, consisting of sand (varying in percentage from 71% to 81%), silt (9% to 16%) and clay (9% to 17%). Only in the capping layer was there evidence of a soil profile, and it was weakly developed. This condition suggests short time-intervals between drives. The composition of the basal layer, which is a stratified deposit, suggests that it was laid down by water.

Odynsky believes that the soil layers were presumably blown into the jump from a nearby source, but he notes at the same time that the soils are not typical of those in the area. Soils in the general region will average about pH 7.2; at the jump they range from pH 4.7 to pH 6.3, most being about 5. In general, soils of the region have very basic reactions, and carbonate accumulations are common, whereas most of the samples from the jump have significant acidic reactions and no indication of a carbonate accumulation. Perhaps the buffalo remains affected the reaction.

The buffalo remains may also have altered the carbon-nitrogen ratio, which is in the order of 10 or more for typical soils of the region. Only the top layer exceeded 10, and most samples had a ratio of little more than 5. Odynsky suggests that these low ratios may result from contamination with the bone, which contains a high percentage of protein and thus of nitrogen.

Odynsky states that the "foregoing information does not appear to warrant any conclusions regarding age or perhaps climatic conditions." But he notes that the type and thickness of soil material between the main bone layers are similar. He attributes the similarity of the soil material to a local source through soil drifting and wonders if the similar thickness of the intervening layers might be attributed to periods of intense drought or other climatic conditions (pers. comm., May 6, 1959).

In a further though inconclusive attempt to obtain information on possible climatic changes, Dr. A. M. Stalker of the Geological Survey of Canada submitted soil samples to his colleague, Dr. J. Terasmae, for pollen analysis. Only two samples were analysed in detail, because of the laborious procedures involved in separating out the pollen, and because of preliminary tests that did not warrant continuing with detailed analysis of other samples. Neither Stalker (pers. comm., February 17, 1959) nor Terasmae (comm. to Stalker, Feb. 17, 1959) feels that any conclusions can be based on the results of analysis.

It is interesting, however, that more pollen is present in the bone layers than in the soil layers. This might suggest a more abundant flora at the time the bone layers were deposited than when the soil layers were laid down. It is also perhaps worthy of mention that pine is over-represented in practically all samples. Stalker believes that it probably blew down from the hills to the west, as it still does; and this in turn suggests that the prevailing winds blew from the same direction in prehistoric times as at present. This may help to account for the repeated use of the jump during the last 2,000 years.

The bone layers consist almost entirely of the remains of buffalo (*Bison*), many of which have been submitted to the Research Council of Alberta. A sample of bones from other animals found in sites in Alberta, among them the Old Women's Buffalo Jump, was submitted to Dr. Wann Langston, palaeontologist for the National Museum of Canada. Among them, he found *Canis* (probably wolf), Rodentia (possibly pocket gopher), an artiodactyl (probably deer), and bird bones. The distinction between dog and wolf is a fine one, and some canine remains could be of large dogs. The presence of wolf is rendered highly probable by Fidler's observations on Indians snaring wolves at buffalo kills (entry for Jan. 27, 1793). These animals were native to the area and only suggest little change in climate. They occur in both bone and soil layers.

CONSIDERATIONS OF AGE

Through the courtesy of Dr. K. J. McCallum, the University of Saskatchewan radiocarbon laboratory provided a number of dates for samples from the Old Women's Buffalo Jump.

Sample	Layer	Material	Years Before Present	Calendar Date (A.D.)
S-87	13	Charcoal	1100 ± 80	860 ± 80
S-89	13	Burned Bone	1020 ± 80	940 ± 80
Average	13	—	1060	900
S-90	17	Burned Bone	1650 ± 60	310 ± 60
S-91	25	Burned Bone	1840 ± 70	120 ± 70

The date for Layer 13 is approximately the age of the transition between the upper and lower members, but this transition is actually still earlier, between Layers 14 and 15, probably dating about A.D. 600. Mulloy has estimated the initial age for the small-point tradition on the Northern Plains at A.D. 500 (1958, p. 222). MacNeish, for Manitoba, believes that the Manitoba focus, the earliest to be characterized by small points, began about A.D. 1000. Small points from Saskatchewan, dated by radiocarbon at about 300 B.C., are found early in the Pelican Lake "Culture." But the later components, of which they are most typical, are Fall River at the Long Creek site, estimated at A.D. 1500–1600; and the Moose Jaw and Mortlach components of the Mortlach site. The earlier of these is thought to date from A.D. 1700 (Wettlaufer, 1955, 1960). Estimates of A.D. 1000 or later for the beginning of the small-point tradition seem much too late. The Manitoba, Fall River, and Mortlach components probably all represent relatively late phases in the small-point tradition.

The dates for the earlier layers (17 and 25) of the lower member at the Women's Jump are compatible with other determinations for the Northern Plains. Besant points are common in Layer 17. Its age of A.D. 310 is close to a radiocarbon date of A.D. 377 for the age of the Besant "Culture" both at the Mortlach Site and at Long Creek, Saskatchewan (Wettlaufer, 1960, p. 114). Layer 25, which contains points similar to Pelican Lake points, is some 400 years younger than the Pelican Lake components at Mortlach and Long Creek (Wettlaufer, 1960, p. 114). As the points are not identical, this temporal difference may represent a time of typological change.

Mulloy, who has personally examined a few points from the lower member of the Old Women's Jump, noted their similarity to some from the lower level of the Billings Bison Trap. Mulloy places this site in his Late Middle Prehistoric Period, which is thought to range from the time of Christ to A.D. 500 (1958, p. 220). There is close agreement between this estimate and the radiocarbon determinations for the lower member points from the Old Women's Jump. Cultural debris below the earliest dated layer at the jump may well extend back to the time of Christ, or possibly beyond.

Concerning the terminal date for the Old Women's Buffalo Jump, three considerations suggest an age of about A.D. 1600. First, the fact that no trade goods were found at the site is an indication of prehistoric age. Secondly, as will be developed, certain point types, which appear to be gaining in frequency in the upper layers of the jump, become still more prevalent in protohistoric components containing trade goods, such as Pictograph Cave IV. Trade goods probably started to penetrate the Northern Plains about A.D. 1700. Thus, as the upper layers of the Old Women's Jump seem to be slightly earlier, they are dated at A.D. 1600. Thirdly, the estimated age for the top layer of the Ross Site, which, as will be seen, is typologically contemporaneous with the top layers at the jump, is between A.D. 1500 and 1700 (Forbis, 1960, pp. 121, 159). An age of A.D. 1600 is accepted here for both Ross III and Layers 1–4 of the buffalo jump.

The cultural zones at the Old Women's Jump, therefore, are thought to be included in a time range between the time of Christ and A.D. 1600. The three radiocarbon ages for Layers 13, 17, and 25 provide further guides for estimating the ages of the various clusters at the jump. These estimates.

which take into consideration physical stratigraphy as well as degrees of typological change, are presented with the full realization that they are tentative and subject to revision.

	Cluster	Estimated Age and Range (A.D.)		Radiocarbon Age (A.D.)
Upper Member			1700	
	Layers 1–4	1600		
			1500	
	Layers 5–6	1400		
			1350	
	Layers 7–8	1300		
			1200	
	Layers 9–10	1100		
			1000	
	Layers 11–14	900		900 (Layer 13)
			600	
Lower Member	Layers 15–22	300		310 (Layer 17)
			200	
	Layers 23–29	100		120 (Layer 25)
			Time of Christ	

In the spring of 1961, Donavan L. Clark, of the United States National Museum, kindly accepted some obsidian samples from the Old Women's Buffalo Jump in connection with a new technique of age determination. Obsidian, in time, hydrates, or takes up water from the atmosphere, resulting in the formation of a distinctive "rim" or crust on outer surfaces. This rim is believed to increase in thickness at a constant rate through time. The rate of hydration is strongly influenced by general temperature conditions. Once the rate is established for an area of similar climate, the age of obsidian samples of unknown antiquity from that area may be calculated from the thickness of the rim of hydration.

The rate of hydration for samples from southern Alberta is not as yet finally determined. Samples from the Old Women's Buffalo Jump were analysed in conjunction with radiocarbon dates, more with the hope of determining this rate than of establishing the age of any given layer. The results were quite consistent, the older specimens on balance having a thicker rim of hydration. It appears tentatively that the layer of hydration increases in thickness at the rate of about 1.5 microns per 1,000 years. A final determination of this rate must await studies by experts. Should the results prove satisfactory, the obsidian dating method could provide a relatively rapid and inexpensive means for dating most sites in southern Alberta.

CULTURAL STRATIGRAPHY

General

For the northern, short-grass Plains, where pottery is relatively scarce, homogeneous, and late in age, archaeologists must rely heavily on projectile points to delineate cultural horizons and to trace similarities between components. About 90 per cent of all artifacts from the Old Women's Jump are projectile points (Table 1).

Casual inspection of the projectile points from the Old Women's Buffalo Jump indicated that there were clear differences between points from the bottom and upper layers. These differences suggested the possibility that certain individual features of points might change consistently through time. This in turn led to the hope that certain distinctive features might prove valuable in establishing a typology and developing a chronology for the dating of other sites in the area.

TABLE 1. *Distribution of artifacts from the Old Women's Buffalo Jump*

	BIFACES					UNIFACES			HEAVY STONE								
LAYER	Projectile points and fragments	Drills and awls	Pointed bifaces	Semilunar bifaces	Biface flakes and fragments	End scrapers	Pointed unifaces	Unifacially chipped flakes	Notched choppers	Choppers	Hammerstones	Smoothers	Pendant	Bead	Bone tools (?)	Pottery	TOTAL
Upper Pit																	
1–2	112				3	1				2	1				1		120
3	221				25			2		3			1				252
4	129	1			6	1				2							139
5	49				1			2		1						1	54
6	56				2					3							61
7	36							1									37
8	29		1														30
9	19		1		1												21
10	28									1							29
11–12	32				2			1									35
13	15				2				4	1	1						23
14	12					1		1		2			UPPER MEMBER				16
15	5												LOWER MEMBER				5
16	9									1							10
17	5							1									6
18	4							1			1						6
19	2																2
20-21	7							1		1							9
22	5							3									8
23	1		1														2
24	2										1						3
25	4									2							6
26	4									1							5
27–29	3																3
Other	87		1						1							3	92
Total	876	1	4	0	42	3	0	13	5	20	4	0	1	0	1	4	974
Lower Pit																	
1-2	82	1			9	1		9			1	1		1			105
3	35				3			1		1							40
4	26							2									28
5	19		1		4			1									25
6	22				2			1									25
7–8	6			2	1			1					UPPER MEMBER				10
9	4												LOWER MEMBER				4
10	4						1	1									6
11	4										1						5
Other	11									?							11
Total	213	1	1	2	19	1	1	16	0	1	2	1	0	1	0	0	259
Grand total	1,089	2	5	2	61	4	1	29	5	21	6	1	1	1	1	4	1,233

While the antiquity so far established for the Old Women's Buffalo Jump by no means approaches the known antiquity of man in southern Alberta, it does seem to provide a projectile point chronology for roughly the last 2,000 years; most archaeological remains in the area are no older. And part of this period, at least, cannot be dated by other means now in use. Radiocarbon dating is not thought to be particularly meaningful for samples of less than 1,000 years of age; and dendrochronology has not yet reached even an infantile state in southern Alberta. The chronology developed for the Old Women's Jump, then, may also find some application in other sciences which require dating of the relatively recent phenomena in the area.

The many steps taken to isolate useful features need not be reported in detail. In general, any feature which seemed to change in time was recorded by percentage for each layer, and these percentages were plotted in stratigraphic order to determine whether they revealed consistent change through time. Many features proved to have no temporal significance. Those found to change through time are described below.

Because some layers yielded substantially the same results when graphed, and because some did not contain sufficient numbers of projectile points for analysis, adjacent layers were grouped into *clusters*: 1 to 4, 5 to 6, 7 to 8, 9 to 10, 11 to 14, 15 and below. Only the specimens from the upper pit were used in the analysis, as they provided a large sample and their stratigraphic relationships were most detailed.

Diagnostic Features of Projectile Points from the Upper Pit

Dimensions. Nearly all features which, in the course of analysis, proved valuable for distinguishing the points of one cluster from those of another relied on measurements. Although time consuming, the method of recording the measurements used in this report was ultimately time-saving. A template of cardboard, 3 by 5 inches in size, was prepared. Openings in the template permitted the recording of appropriate measurements at indicated places on 3- by 5-inch slips of paper; one slip for each point. The measurements were obtained by placing the points on a sheet of graph paper graded into millimetres and centimetres, and by reading the dimensions from the graph paper.

At first, a large number of dimensions were secured; some, being useless for typological purposes, were struck. Others were added when they proved chronologically useful (Figure 6). The final template had positions for

(1) Length,
(2) Width at base,
(3) Width of body,
(4) Width at neck,
(5) Notch width, and
(6) Height of basal edge.

Other positions in the template provided room for

(1) Specimen number,
(2) Excavation unit and layer,
(3) State of completeness, and
(4) Convexity or concavity of base.

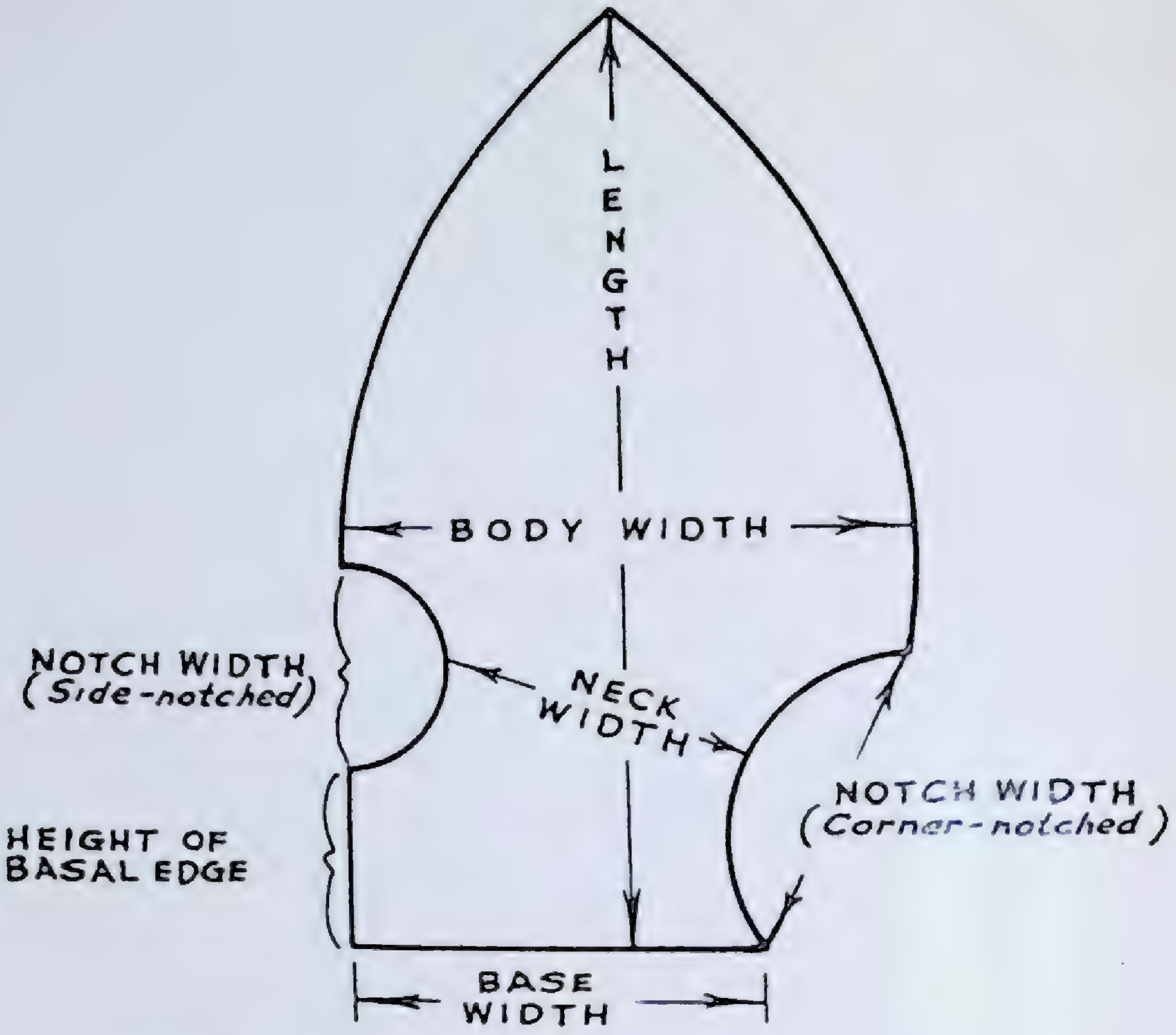


FIGURE 6. Diagram illustrating terminology of projectile point dimensions.

In order to minimize error, the points were measured twice, and the resultant figures were then compared. While some discrepancies did appear, they were minor, and the second run substantiated the results of the first.

Accuracy was held to a millimetre. Indications are that even finer measurements would be more revealing, particularly when the relation of one measurement to another is at stake. Perhaps specially-made calipers, calibrated into tenths of millimetres, would make many distinctions sharper. However, the trends are clear. And if visual inspection to the nearest millimetre is somewhat less precise than it might be, it is still more practical than the use of special instruments.

Length. In the upper member, points are dispersed from a minimum of 10 mm to a maximum of 42 mm in length. Most are in the range of 20 to 24 mm (132 specimens). Under 20 mm, there are 101 points; and over 24 mm, there are 104 points. These ranges can be roughly expressed in a different way: the average measurement for points in each cluster tends to be near 23 mm; the farther they are from this, the fewer points there are.

Points from the lower member (Layer 15 and below), taken as a whole, average 33.6 mm in length, or about one centimetre longer than those of the upper member. They range from 23 to 55 mm. They are fairly evenly distributed in a continuum, the major breaks being in the 29 to 32 mm range, and the 40 to 43 mm range. A few fragments seem to be from points longer than the longest measurable specimen.

Base width (Figure 7). Side-notched points are not generally considered to have a base distinct from the body. The term *base* here is used to distinguish that portion of a projectile point below the notches from the *body*, that portion above the notches and including the tip.

In the upper member, the base diminishes gradually in width, going back in time, from an average of 13.5 mm in Layers 1 to 4 to an average of 12.1 mm in Layers 11 to 14. The mode (the width of most frequent occurrence) declines from 14 mm in the upper layers to 11 in the bottom of the upper member. In the lower member, average base width increases abruptly to 17.1, and the mode to 18.

Body width, expressed as an average, remains constant at 12.8 to 12.9 mm in Layers 1 to 8; in Layers 9 to 14, it increases sharply to 13.6 mm (Figure 7). The mode throughout the upper member is usually 13 mm. In the lower member, the average body width is much greater, at 20.6 mm, and the mode is 23 mm.

Base-body index (Figure 7). While both base and body width appear to be chronologically useful, a still more significant figure is derived by dividing the average body width by the average base width for each cluster, and multiplying by 100. The chief advantage of the base-body index is that it serves to minimize differences in measurements made by two or more individuals. Even if average variations were consistently as much as one millimetre, the base-body index would remain nearly the same; and the results of independent studies should be comparable. In contrast, simple base and body measurements could be seriously out of line with the dimensions of points from the Old Women's Jump if the average difference were even one millimetre.

A base-body index below 100 indicates that the base is wider than the body; above 100, the body is wider than the base. The base-body index increases gradually going back in time, from 96 in Layers 1 to 4 to 120 in Layers 15 and below. Point clusters with an average base width greater than body width are limited to Layers 1 to 6.

Relation of base width to body width (Figure 8). The base may be wider or narrower than the body; if the difference in width is less than one millimetre, they are considered to be equal. For each cluster, the points were segregated according to the width of the base in relation to the body (wide, narrow, and equal), and the percentage of each category was then determined. A graph, prepared with all clusters in stratigraphic order, revealed a clear tendency for wide-base points to become increasingly more popular, from zero in Layer 15 and below, to 72.2 per cent in Layers 1 to 2. The reverse is true of narrow-base points. Points with bases and bodies of equal width, comprising almost half the specimens in Layers 5 to 8, are transitional.

Width at neck. This measurement is primarily useful for distinguishing lower member from upper member points. Presumably the width at the neck is directly related to the diameter of the shaft to which the point was attached; a change in such diameters in the Old Women's Jump sequence may represent the transition from the use of an atlatl or spear (in the lower member) to the bow and arrow (in the upper member).

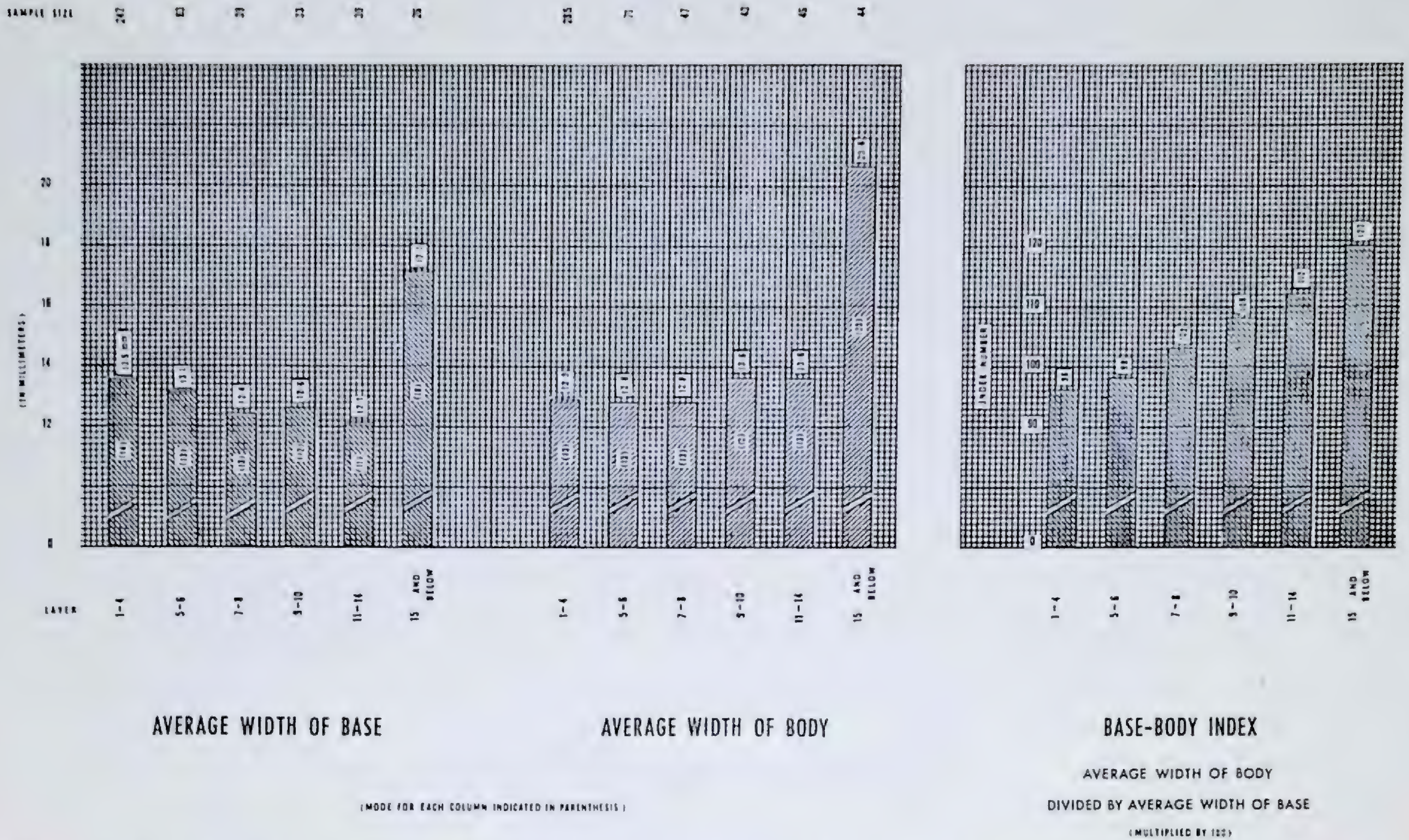


FIGURE 7. Graph showing average width of base and body, and base-body index, arranged according to clusters of layers. Upper pit.

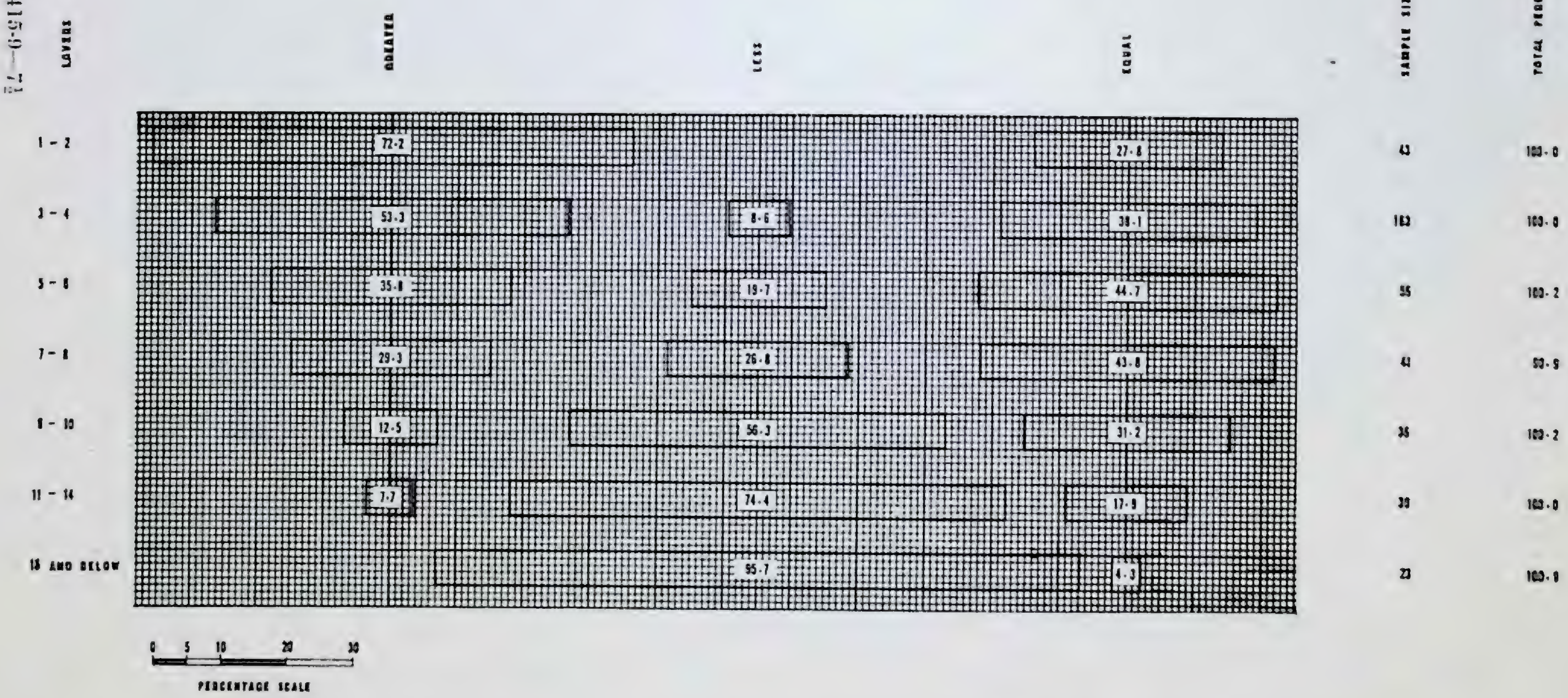


FIGURE 8. Graph showing percentages of projectile points with base width greater than, equal to, or less than body width, arranged according to clusters of layers. Upper pit.

In the upper member (529 specimens), the average width at the notches tends to be 8 mm, each cluster varying no more than .7 mm from this average. The mode is usually 8 or 9 mm, and the range is from 5 to 11 mm, excepting a few specimens only 4 mm across and two points of unusual width (12 and 14 mm).

The contrast in the lower member is striking. Here width at the notches averages 12.6 mm (40 specimens). The mode is 12 mm, and the range is from 8 to 18 mm.

Height of basal edge (Figure 9). The lateral distance between the notch and the base is the height of the basal edge. It is present on all side-notched points and may be present on corner-notched points. Where not present, it is assigned a value of 0 mm, and this value is used in calculating the average height of the basal edge for each component. Where the basal edge is of different heights on the two edges of a projectile point, an average value is taken.

Because many points in the lower member are corner-notched, the average height of the basal edge is only slightly over 1 mm, increasing gradually to 4.41 mm in Layers 1 to 4. The mode runs from 0 to 5 mm through the same layers.

Notch width (Figure 9) is the distance across the opening of the notch at its mouth. If this measurement is not the same on both edges of the point, an average is taken. Very few points from the Old Women's Buffalo Jump lack notches.

Notch width increases in average from an even 3 mm in Layers 1 to 4 to 4.14 mm in Layers 11 to 14. The mode in Layers 1 to 6 is 3 mm; in Layers 7 to 14, it is 4 mm. The larger, heavier points from the lower member have an average notch width of 6.32 mm, the mode being 7 mm.

HBE-NW index (Figure 9). The relationship of the basal edge to the width of the notch is reckoned by dividing the average height of the basal edge (HBE) by average notch width (NW) and multiplying by 100. A figure of over 100 indicates that the basal edge height is greater than notch width; less than 100, the notch width is greater. Like the base-body index, this ratio is less likely to be influenced by individual whims in measurement than simple statements of dimensions.

The index increases consistently from early to late times. In Layers 1 to 4, the index is 147; in Layers 11 to 14, it is 43. The trend continues even into Layer 15 and below (Index: 18), where stemmed points predominate. The HBE-NW index appears to be one of the most reliable chronological indicators.

Relation of height of basal edge to notch width (Figure 10). The height of the basal edge may exceed, or be equal to, or less than, the notch width. Percentages calculated for these three possibilities, and arranged stratigraphically by cluster, indicate a strong trend for the height of the basal edge to be greater than notch width in later times, and the opposite in earlier times. As might be expected, points with the notch width equal to the height of the basal edge occur most prominently (about 25 per cent) in intermediate layers (5 to 10).

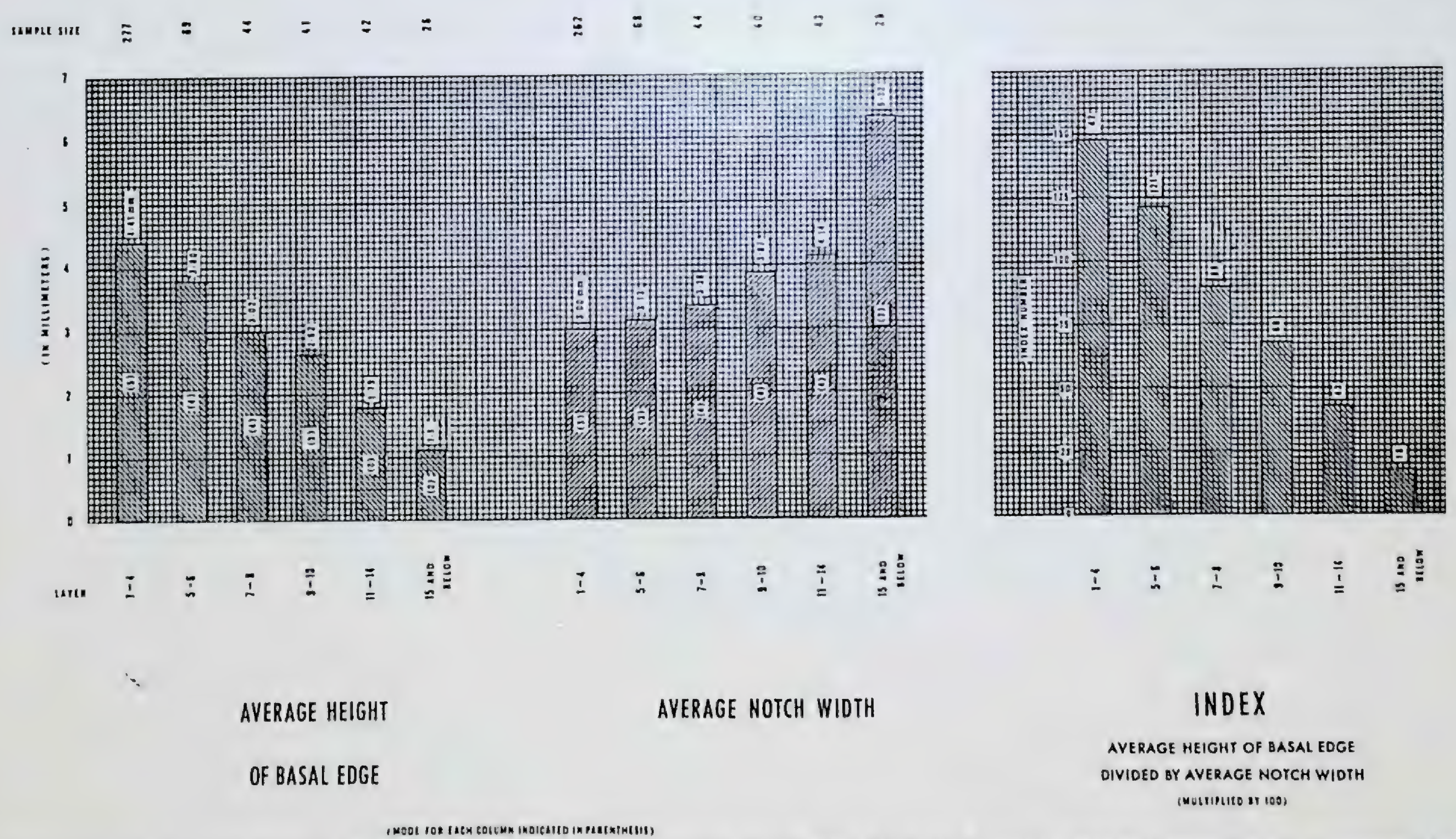


FIGURE 9. Graph showing average height of basal edge, average notch width, and HBE/NW index, arranged according to clusters of layers. Upper pit.

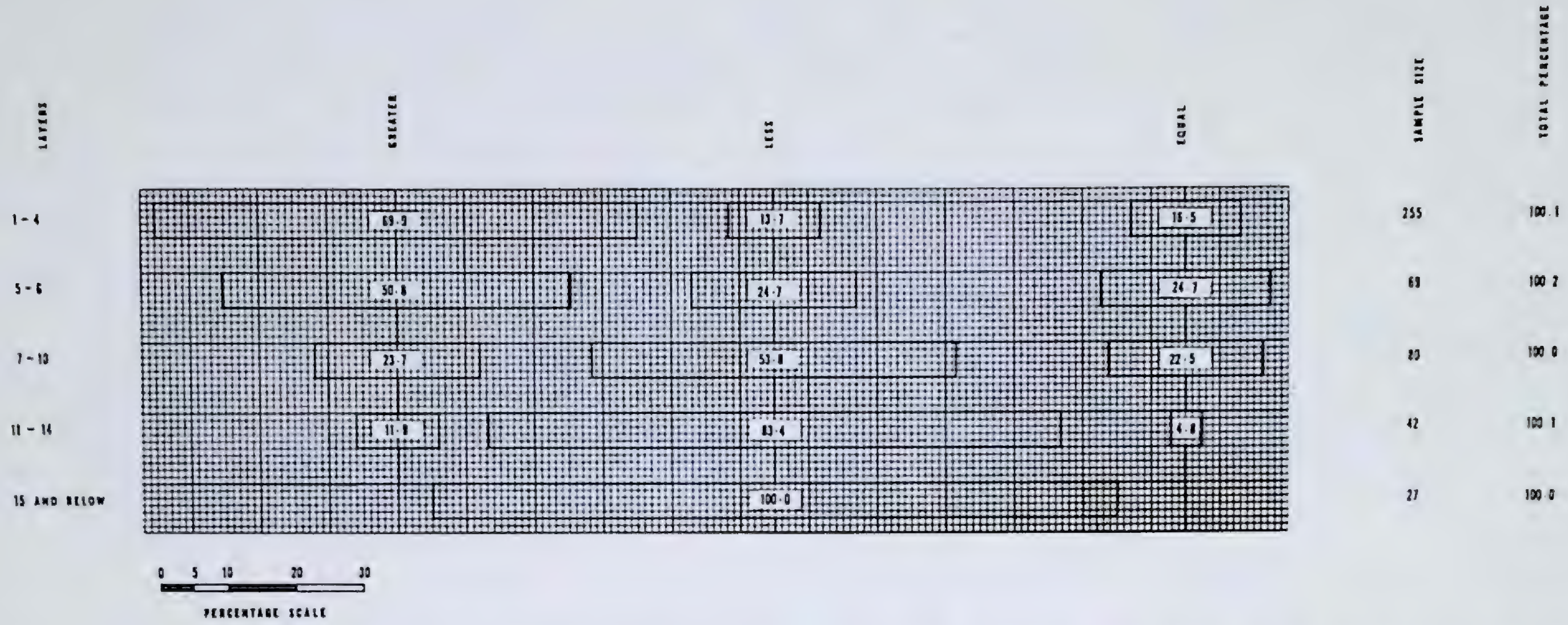


FIGURE 10. Graph showing percentage of projectile points with height of basal edge greater than, equal to, or less than notch width, arranged according to clusters of layers. Upper pit.

Acute notches. Recognition of acute notching by visual inspection proved inconclusive because of shifting attitudes toward the trait. Finally it was calculated on a mathematical basis. Depth of the notch was calculated by subtracting the width *at* the notches from the greatest width, and dividing the result by two (to account for both edges of the point). The width *of* the notch has already been discussed. Acute notches were defined as those with a depth greater than width. If notch width and notch depth proved to be equal, the notch was not regarded as acute. Acute notching becomes increasingly more popular in later times:

Layers	Percentage of Points with Acute Notches	Sample Size
1–4	31.5	252
5–6	24.3	66
7–8	19.5	41
9–10	5.2	39
11–14	2.4	43
15 and below	0.0	25

Corner notches. By far the greater number of points from the upper member of the Old Women's Buffalo Jump are side-notched. In the earlier layers, however, corner notching is extremely common; furthermore, in the lower member, nearly two-thirds of all analysable specimens are corner-notched (although, generally, large and heavy corner-notched specimens are more conventionally termed "stemmed").

Layer	Percentage of Corner-Notched Specimens	Total Sample
1–4	1.2	258
5–6	1.6	63
7–8	17.1	41
9–10	27.1	37
11–14	41.4	41
15 and below	61.5	26

There are few difficulties in distinguishing side-notched from corner-notched points by visual inspection although the occasional problem arises. In the terminology used in this section, the basic criterion for distinguishing corner-notched points is simple: corner-notched points have no basal edge. If there is a determinable basal edge (no matter how much narrower the base may be than the body), the point is side notched. While this terminology may be unconventional, the results based on it are probably not significantly different from those that would be obtained using other more common definitions of corner notches.

Basal notches. Two specimens, from Layers 1 and 3, have clearly defined basal notches in addition to side notches. Their stratigraphic position suggests a very recent age for basal notching. This suggestion is supported by evidence from Pictograph Cave, where prehistoric Layer III contained no basally notched points, although the overlying Layer IV, a later component, yielded many.

Index of base shape. This index was reckoned by assigning a value of +1.00 to points with convex bases, zero to points with straight bases, and —1.00 to points with concave bases. The cumulative values for all points in a cluster were then totalled, and the sum was divided by the number of points in the sample. A cluster of points all having convex bases thus has an index of +1.00; those with concave bases, an index of —1.00.

There is an evident trend toward basal concavity in later times at the Old Women's Buffalo Jump, from an earlier condition of convexity. However, in all clusters, a straight base is most common.

Layer	Index of Base Shape	Sample Size
1–4	−.29	246
5–6	−.08	61
7–8	+.03	39
9–10	+.05	37
11–14	+.25	36
15 and below	+.35	23

Typology

Once the features of chronological significance, described above, had been isolated, it seemed likely that certain combinations of features would produce valid projectile point types for the upper member. As with individual features, the types had to prove their historicity; this was regarded as established if trial types, when graphed by percentages in stratigraphic order, produce normal curves reflecting consistent change in frequency through time. If they did not, the trial types were conceptualized in different terms until a satisfactory curve resulted. After several attempts, in which Dr. R. S. MacNeish, National Museum of Canada, played a most helpful role, seven compatible normal curves were discovered. Each curve is thought to represent the historical trend for each of seven types, which were given arbitrary names in alphabetical order.

In establishing types, the actual projectile points were used, rather than the index cards which had helped in isolating important individual features. There were two reasons for this: (1) the index cards proved awkward and unmanageable in the search for combinations of features (although punch cards might be practicable), and (2) the possibility of error in recording the file cards was recognized. A point typology, based on actual specimens, seemed to be an ideal method for checking the results obtained with the index cards. The results did check.

The historical trend, for each type described below, is distinctive (Figure 11; Table 2). Three types, Washita, Pekisko, and Paskapoo, tend to be late in time, being most common in the upper layers of the jump. Nanton points, though occurring in large percentages throughout the sequence, are most abundant in the middle layers. And the three remaining types—Lewis, Irvine, and High River—are virtually limited to the lower part of the upper member and are therefore the earliest specimens in the small point traditions at the Old Women's Buffalo Jump.

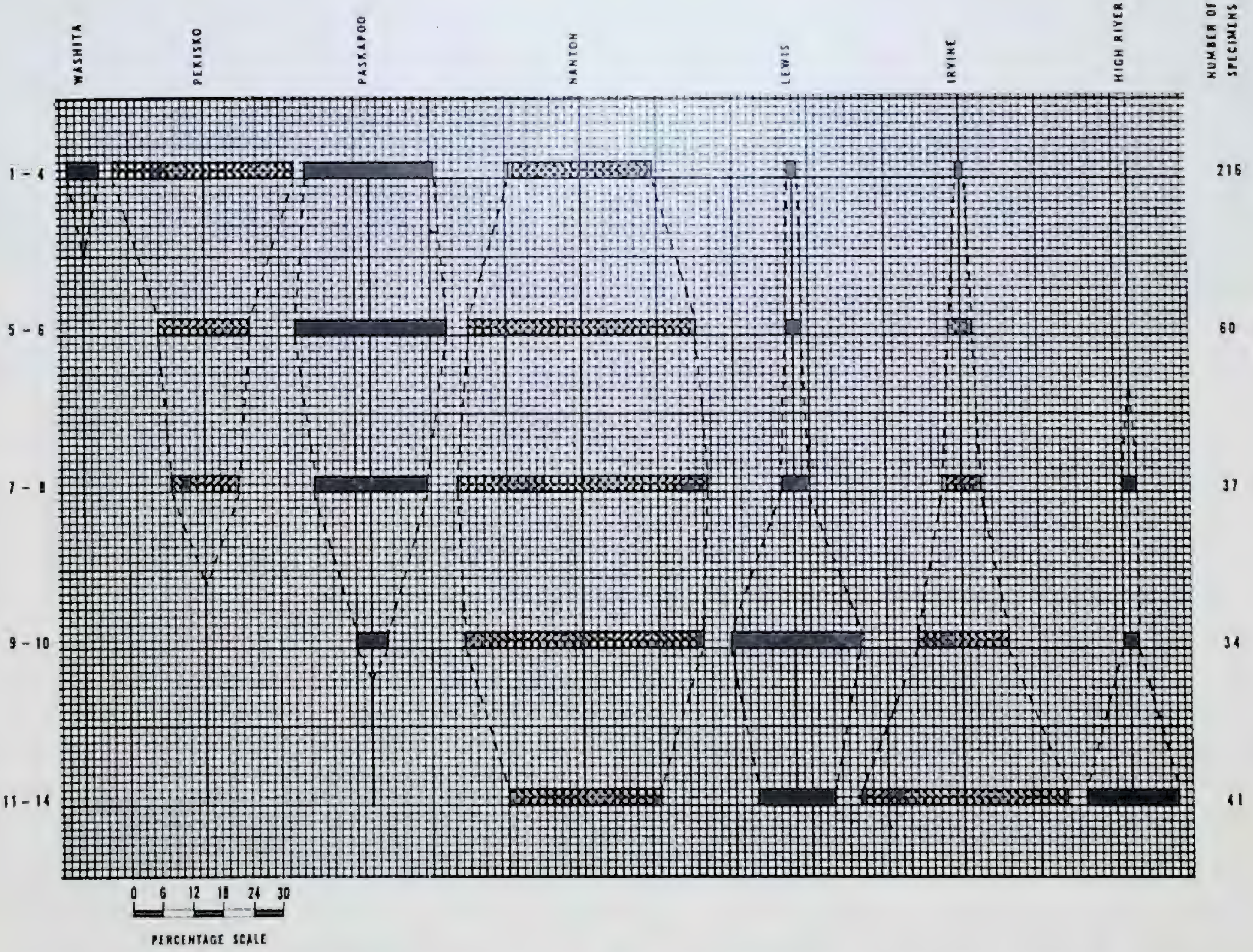


FIGURE 11. Graph showing percentages of projectile point types arranged according to clusters of layers. Upper pit, upper member.

Table 2. *Distribution of projectile point types from the upper pit, upper member (Percentages in parentheses)*

Layer	Washita	Pekisko	Paska-poo	Nanton	Lewis	Irvine	High River	Total
1–4	15 (7.0)	77 (35.7)	58 (26.8)	63 (28.2)	2 (.9)	1 (.5)	....	216 (100.1)
5–6	....	11 (18.4)	18 (30.0)	26 (43.3)	2 (3.3)	3 (5.0)	....	60 (100.0)
7-8	....	5 (13.5)	8 (21.6)	18 (48.7)	2 (5.4)	3 (8.1)	1 (2.7)	37 (100.0)
9–10	....	....	2 (5.9)	16 (47.1)	9 (26.5)	6 (17.7)	1 (3.0)	34 (100.2)
11–14	....	....	....	12 (29.3)	6 (14.6)	16 (39.1)	7 (17.1)	41 (100.1)

Projectile Point Types from the Upper Pit, Upper Member

WASHITA POINTS (Figure 12, A–C)

Diagnostic features. (1) Side notches; (2) Base wider than blade by at least 1 mm; (3) Flaring basal edges; (4) Height of basal edge greater than or, rarely, equal to notch width.

General characteristics. (1) Base usually concave, sometimes straight; (2) Base sometimes ground; (3) Notches either acute or open; (4) Bifacial dressing common; (5) Length-width proportions from 1:1 to 2.5:1; (6) Wide range of lithic materials; (7) Shoulders usually straight, sometimes sloping; (8) Dimensions (*see* Table 3).

Comparable specimens. Mortlach, Mortlach Culture (Wettlaufer, 1955, Pl. 1, No. 8), Pictograph Cave IV (Mulloy, 1958, Fig. 25, Nos. 1, 3–5).

Comments. At the Women's Jump, all 15 specimens are from Layers 1 to 4, suggesting a life span estimated to begin about A.D. 1500. This is supported by finds at Mortlach and Pictograph Cave, where the type occurs always in the top layer. At Pictograph Cave the points have basal notches, another late feature in the jump series. (One Washita point from the lower pit has a basal notch.) Pictograph Cave IV is protohistoric. The type probably increased in frequency from Layers 1 to 4 on, until metal replaced stone for points.

Bell named the type in Oklahoma, where Washita points are estimated to range in age from A.D. 1100 or 1200 to A.D. 1500 or 1600. Thus on the Northern Plains they appear to be later in time. Bell notes that they are also found in sedentary Plains cultures, in the Anasazi of the Southwest, and in Mississippian cultures (1958, p. 98).

Washita points, at the Women's Jump, appear to have developed from Pekisko points.

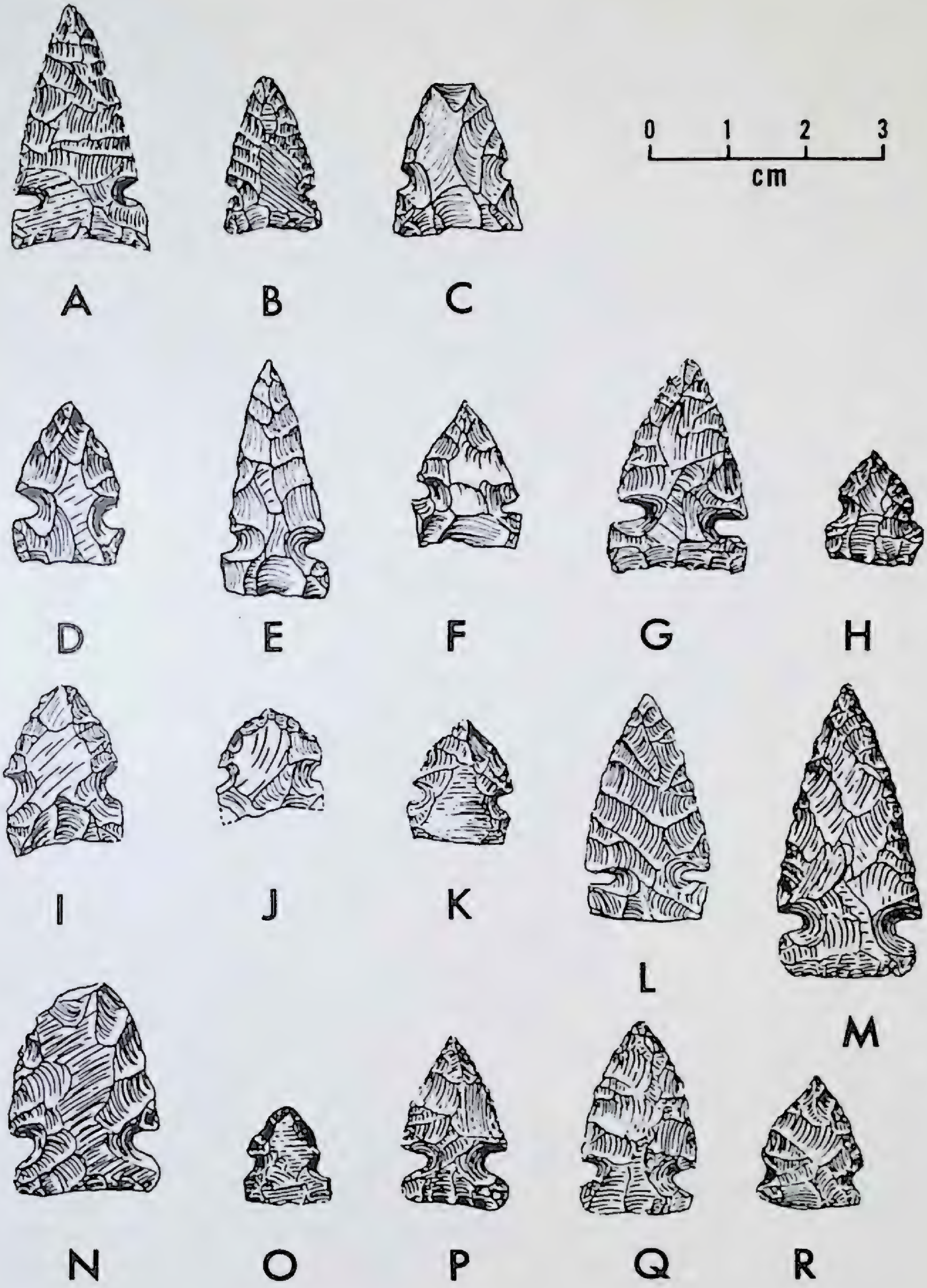


Figure 12. Drawings of projectile points from the upper pit, upper member. A–C, Washita; D–H, Pekisko; I–M, Paskapoo; N–R, Nanton.

TABLE 3. *Dimensions of projectile point types from the upper pit, upper member (in millimetres)*

—	Length			Width			Neck Width			Average Weight (grams)
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	
Washita	19	33	24.3	12	18	14.5	6	11	8.4	1.0
Pekisko	15	35	23.4	11	18	14.8	6	11	8.6	1.1
Paskapoo	14	42	22.8	10	19	14.4	6	13	8.7	1.4
Nanton	11	37	20.2	8	20	12.9	5	12	7.9	.9
Lewis	17	33	22.6	10	16	13.7	5	10	7.7	1.0
Irvine	15	35	22.3	9	19	13.4	5	11	7.9	1.1
High River	21	25	22.0	12	15	13.8	7	10	8.5	.9

PEKISKO POINTS (Figure 12, D–H)

Diagnostic features. (1) Side notches; (2) Base wider than blade by at least 1 mm; (3) Height of basal edge greater than notch width.

General characteristics. (1) Base straight or concave; (2) Base sometimes ground; (3) Notches either acute or open; (4) Bifacial dressing common; (5) Length-width proportions from 1:1 to 2.5:1; (6) Wide range of lithic materials; (7) Shoulders generally straight, sometimes sloping, very rarely slightly barbed; (8) Dimensions (*see* Table 3).

Comparable specimens. Selkirk and Manitoba foci (MacNeish, 1958, Pl. 7, No. 6); Long Creek Site, Fall River Culture (Wettlaufer, 1960, Pl. 7, Nos. 1, 2; Pl. 8, No. 1); Mortlach Site, Mortlach Culture (Wettlaufer, 1955, Pl. 1, No. 7); Pictograph Cave IV (Mulloy, 1958, Fig. 25, Nos. 7 to 10); Pictograph Cave III (Mulloy, 1958, Fig. 6, Nos. 34, 37, 41, 49); Ghost Cave (Mulloy, 1958, Fig. 29, No. 12).

Comments. At the Old Women's Buffalo Jump, 93 Pekisko points occur, most frequently in Layers 1 to 4. They are estimated to have a time span beginning about A.D. 1200 (in Layer 8) and achieving greater frequency into protohistoric times.

Their late position is also suggested by finds from Manitoba, where they occur in foci attributed to the Cree and Assiniboine Indians, foci thought to range from A.D. 1000 into the protohistoric. In Saskatchewan, at Long Creek, the Fall Creek Culture is estimated at A.D. 1500–1600; and at Mortlach, the Mortlach Culture is said to begin about A.D. 1750. Both "cultures" lie at the top of multi-component stratified sites. In Montana, Pictograph Cave IV is protohistoric and thus of comparable age. Pictograph Cave III and Ghost Cave are Late Prehistoric, a period estimated by Mulloy to begin about A.D. 500 (1958, p. 222), but this estimate may be too early for Pictograph Cave III, Ghost Cave, and for Pekisko points.

Pekisko points overlap with "Reed" points from Oklahoma (Bell, 1958, p. 76). Both MacNeish (1958, pp. 103–104) and Wettlaufer (1955, p. 22) have used the term "Plains Side-notched"; and Wettlaufer (1960, p. 31) has designated some of them as "Prairie Side-notched."

Pekisko points may have evolved from, and alongside, Paskapoo points.

PASKAPOO POINTS (Figure 12, I–M)

Diagnostic features. (1) Side notches; (2) Base width equal to body width; (3) Height of basal edge greater than notch width.

General characteristics. (1) Base usually straight or concave, rarely only slightly convex; (2) Base sometimes ground; (3) Notches either acute or open; (4) Wide range in chipping technique, generally good; (5) Length-width proportions from 1:1 to 2.5:1; (6) Shoulder usually straight, sometimes sloping; (7) Dimensions (*see* Table 3).

Comparable specimens. Mortlach Site, Moose Jaw (Wettlaufer, 1955, Pl. 3, No. 5); Pictograph Cave IV (Mulloy, 1958, Fig. 25, No. 2); Pictograph Cave III (Mulloy, 1958, Fig. 6, Nos. 40, 42); Ghost Cave (Mulloy, 1958, Fig. 29, Nos. 1, 8, 9, 10, 13, 14).

Comments. At the Old Women's Jump, the 86 Paskapoo points occur through Layers 1 to 10, being most common in the later part of the period. They are estimated to begin their life span at about A.D. 1000, continuing into the protohistoric, although probably in decreasing frequencies.

Ghost Cave and Pictograph Cave III are thought to be nearly contemporaneous; both are earlier than Pictograph Cave IV (Mulloy, 1958). Paskapoo points seem to be more common in the two earlier components than in the more recent ones, thus lending some support to their dating at the jump. However, confirmation would depend on a statistical analysis of all actual specimens from the Montana components, not on selected illustrations which do not necessarily show a representative sample.

Wettlaufer, who has used the term "Prairie Side-notched" for similar specimens, has estimated the Moose Jaw "Culture" to fall within the period A.D. 1700–1750 (1955, p. 81). If so, the type probably lasted until metal replaced stone in the construction of projectile points.

Paskapoo points probably developed from Nanton points, varying only in respect to the relationship between the basal edge and notch width.

NANTON POINTS (Figure 12, N–R)

Diagnostic features. (1) Side notches; (2) Base width equal to or greater than body width; (3) Height of basal edge equal to or less than notch width.

General characteristics. (1) Basal edge may be absent on occasion, but in these cases base always wider than body; (2) Base usually straight, may be convex or concave; (3) Base sometimes ground; (4) Wide or, rarely, acute notches; (5) Chipping technique highly variable, generally poor; many flake points; (6) Length-width proportions roughly 1:1 to 2.5:1; (7) Wide range of materials; (8) Shoulders generally sloping, sometimes straight; (9) Dimensions (*see* Table 3).

Comparable specimens. Stott Mound and Village (MacNeish, 1954, Pl. 5, No. 4); Selkirk Focus (MacNeish, 1958, Pl. 7, No. 1); Selkirk and Manitoba Foci (MacNeish, 1958, Pl. 7, Nos. 4, 5, 12–15); Long Creek Site, Fall River Culture (Wettlaufer, 1960, Pl. 7, No. 5; Pl. 8, Nos. 5, 12, 13; Avonlea Culture, Pl. 11, No. 2); Pictograph Cave III (Mulloy, 1958, Fig. 6, Nos. 35, 36, 38, 39, 43–48, 50); Ghost Cave (Mulloy, 1958, Fig. 29, Nos. 3, 4, 11, 25).

Comments. At the Old Women's Buffalo Jump, 135 Nanton points occur throughout Layers 1 to 14, comprising about one-half the specimens in the middle of the small-point sequence (Layers 7 to 8). They diminish in frequency both in earlier and later times. Their time range is estimated at A.D. 600–1700.

Just as they are abundant at the jump, so they are common throughout the Northern Plains. At other localities, they persist into protohistoric times (Stott, Long Creek), but their apparent absence at Pictograph Cave IV suggests that they do indeed decline in frequency in late times, as indicated at the Old Women's Jump. Nanton points occur in Pictograph Cave III and at Ghost Cave, both prehistoric components, in large numbers. But the earliest comparable specimen, from the sites listed above, is from the Avonlea "Culture" at the Long Creek Site. The single specimen was found with nine Avonlea points. Wettlaufer estimated the Avonlea "Culture" at between A.D. 1000–1500 (1960, p. 114); but at the type site, Avonlea points have been dated by radiocarbon at A.D. 460±100 (McCallum and Dyck, 1960, p. 80, S–45).

Some Nanton points have been designated by other terms: "Prairie Side-notched," "Plains Side-notched," and "Selkirk Side-notched." At the Women's Jump, they seem to develop from Irvine points, from which they differ mainly in the relationship of the width of the base to the width of the body.

LEWIS POINTS (Figure 13, A–D)

Diagnostic features. (1) Base narrower than body by at least one millimetre; (2) Basal corner rounded; (3) Height of basal edge less than notch width.

General characteristics. (1) Usually corner-notched, some tending to be side-notched; (2) Base straight or convex rarely concave; (3) Base sometimes ground; (4) Wide notches; (5) Chipping generally poor but bifacial; (6) Length-width proportions from 1:1 to 2:1, rarely longer; (7) Material commonly quartzite in Layers 9 to 10; quartzite and dull, black stone in Layers 11 to 14; (8) Shoulder straight or sloping; (9) Dimensions (*see* Table 3).

Comparable specimens. For Northern Plains, none illustrated from sites under consideration.

Comments. At the Women's Jump, of 21 specimens, Lewis points are most common in Layers 9 to 10, estimated in age at about A.D. 1100, with a total life span estimated at A.D. 600–1600.

Lewis points may be derived from larger specimens of similar outline found in the lower member; they are not obviously ancestral to later types at the jump.

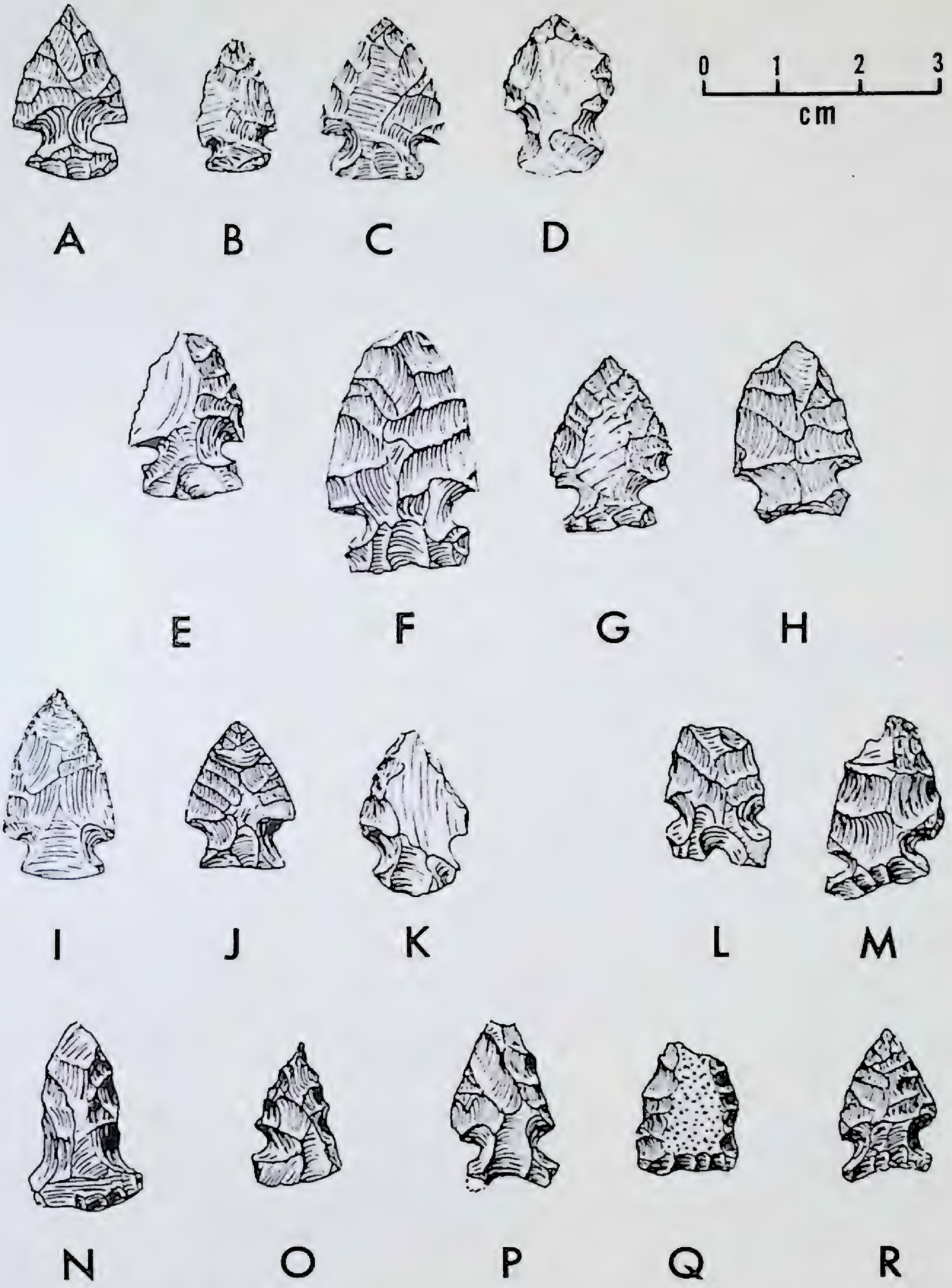


Figure 13. Drawings of projectile points from the upper pit, upper member. A–D, Lewis; E–H, Irvine; I–K, High River; L–R, point forms and styles.

IRVINE POINTS (Figure 13, E–H)

Diagnostic features. (1) Side notches; (2) Base narrower than body by at least one millimetre; (3) Basal edge forms angle with base.

General characteristics. (1) Base usually straight, rarely concave or convex; (2) Base sometimes ground; (3) Wide or acute notch; (4) Length-width proportions between 1:1 and 1:2, rarely longer; (5) Dull black stone common material in earlier layers; (6) Shoulder straight or sloping; (7) Dimensions (*see* Table 3).

Comparable specimens. Stott Mound and Village (MacNeish, 1954, Pl. V, No. 3); Long Creek Site, Avonlea Culture (Wettlaufer, 1960, Pl. 11, No. 1).

Comments. At the Old Women's Buffalo Jump, Irvine points occur throughout the upper member but are most prevalent in Layers 9 to 14, estimated to span the years A.D. 600–1200.

At the Stott Mound, the points are late in time, if estimates placing this component in the very late prehistoric and early historic periods are correct. It is doubtful that Irvine points should be compared with Avonlea points of the Long Creek Site, as the latter are distinctive for their especially fine technique of manufacture, whereas Irvine points are only moderately well made. Avonlea points appear to be earlier (*see* "Comments," NANTON points).

HIGH RIVER POINTS (Figure 13, I–K)

Diagnostic features. (1) Corner notches; (2) Base narrower than body by at least one millimetre; (3) No basal edge.

General characteristics. (1) Base straight to highly convex; (2) Base sometimes ground; (3) Wide notches; (4) Chipping highly variable; (5) Length-width proportions between 1.5:1 and 2:1; (6) Straight to sloping shoulder; (7) Dimensions (*see* Table 3).

Comparable specimens. Stott Mound and Village (MacNeish, 1954, Pl. 5, No. 5); Mortlach Site, Moose Jaw Culture (Wettlaufer, 1955, Pl. 3, No. 9); Mortlach Site, Pelican Lake Culture (Wettlaufer, 1955, Pl. 11, Nos. 4, 5).

Comments. At the Old Women's Jump, High River points are virtually restricted to Layers 11 to 14. Layer 13 has a radiocarbon dating of A.D. 900±80 (McCallum and Dyck, 1960, p. 79). The life span of the type, beginning at an estimated A.D. 600, is about 750 years.

At the Mortlach site, High River points appear in contexts of much different age. The Moose Jaw "Culture" is estimated at A.D. 1700–1750. Stott corner-notched points in Manitoba are also thought to be "present mainly on the early historic horizon" (MacNeish, 1954, p. 40). The Pelican Lake "Culture" of Mortlach has been cross-dated by radiocarbon from the Long Creek Site at B.C. 293±100 (Wettlaufer, 1960, p. 114). The dates for High River points at the Old Women's Jump are thus intermediate between Moose Jaw (and Stott) and Pelican Lake, perhaps indicating a long life-span for the type. In the Pelican Lake "Culture" they occur with large corner-notched points, from which they are possibly derived.

OTHER PROJECTILE POINTS FROM THE UPPER PIT, UPPER MEMBER

Single specimens which do not readily fit into any of the foregoing types will be designated as *forms;* groups of aberrant points, as *styles.*

UM STYLE 1 (Figure 13, O) consists of seven specimens which are distinctly notched along one edge, but not along the other (although it may be slightly indented). The base is frequently not at right angles to the long axis. The specimens are generally small, ranging from 15 to 23 mm in length and from 8 to 12 mm in width. They are found throughout Layers 1 to 6.

UM STYLE 2 is comprised of two specimens, similar to Pekisko or Paskapoo points in all respects except in the definite notching of the base (Figure 13, L). They are from Layers 1 and 3.

UM STYLE 3 (Figure 13, R) points are similar in outline to the Avonlea type, locally known in Alberta as the "Upper Kill Type" (Forbis, 1960, pp. 138–139). The two points are not so finely made as Avonlea but have the low basal edges and concave base which render them distinctive. They were found in Layers 5 and 7, and thus appear to be unusually late for Avonlea points (*see* "Comments," NANTON points).

UM FORM 1 is a flake point either not notched, or with incipient notches (Figure 13, Q). The single specimen from the upper pit is based on a flake, which has been chipped to a bevel on all edges. Small, it is from Layer 2; and the specimen from the lower pit was found in a layer equivalent to Layers 11 to 12.

UM FORM 2 is a point lacking notches (Figure 13, N). Distinctively, both lateral edges are recurved (concavo-convex). Probably the shoulder area above the notches has been broken along both edges. Thick, the point is 23 mm long and has its maximum width (14 mm) at the base. It was found in Layer 4.

UM FORM 3 is a side-notched point, possibly rechipped to a skewed base, although the position of the notches suggests that the present form is deliberate (Figure 13, M). Over-all chipping is excellent, and it is of usual size for a point from the upper member. It is from Layer 3.

UM FORM 4 is a side-notched point with deep basal thinning (Figure 13, P). The base is strongly concave, and, in conjunction with the notches, its shape lends the point an eared effect. Fairly thick, it is 22 mm long, 13 mm wide; it originated in Layer 3.

PROJECTILE POINTS FROM THE LOWER PIT, UPPER MEMBER

Almost all small notched points from the lower pit conform typologically to those from the upper pit. In the lower pit, they occur in Layers 1 to 9, which are stratigraphically the equivalent of Layers 1 to 14 in the upper pit (*see* "Stratigraphic Correlations"). A problem exists here with regard to the exact equivalent of Layer 9 (lower pit) in that depth prevented tracing it to discover its equivalent layer in the upper pit and in that some large stemmed projectile points originated in Layer 9. In the upper pit, all such points were restricted to strata below Layer 14.

The distribution of projectile points from the lower pit serves to substantiate the typology developed for the upper pit (Table 4). Late types—Washita, Pekisko, Paskapoo—occupy the top layers in the sequence; and the early types—Lewis, Irvine, High River—the lower layers (Table 3). The principal differences are—(1) more Pekisko and Paskapoo points appear in earlier layers in the lower pit than in the upper; and (2) High River points occur in later times.

TABLE 4. *Distribution of projectile point types from the lower pit, upper member (Percentages in parentheses)*

Layer	Washita	Pekisko	Paska-poo	Nanton	Lewis	Irvine	High River	Total	Correlative Layers in Upper Pit
1–2	4 (7.0)	20 (35.2)	13 (22.8)	17 (29.8)		2 (3.5)	1 (1.8)	57 (100.1)	1–2 Upper 3
2–3	1 (11.1)	4 (44.5)	4 (44.5)					9 (100.1)	3
3	1 (4.3)	6 (26.1)	9 (39.2)	6 (26.1)		1 (4.3)		23 (100.0)	Lower 3
4		4 (33.3)	1 (8.3)	7 (58.3)				12 (99.9)	Top of 4–10
5		4 (28.6)		6 (42.8)	1 (7.2)	1 (7.2)	2 (14.3)	14 (100.1)	Bottom of 4–10
6		1 (7.2)	2 (14.3)	4 (28.6)	2 (14.3)	4 (28.6)	1 (7.2)	14 (100.2)	11–12
7–9				2 (50.0)		1 (25.0)	1 (25.0)	4 (100.0)	13–14

The main significance of excavations in the lower pit, then, is that they indicate that the same types occupy approximately the same layers as in the upper pit and occur in roughly the same frequencies. Thus it seems highly unlikely that the distribution of point types in the upper pit is fortuitous. The types fall into an orderly chronological arrangement.

Two points from the lower pit are unique, UM FORM 1. One is a small, thin specimen, lacking the characteristic notches of other points from the upper member (Figure 19, D). From Layer 6 (equivalent to Layers 11 to 12 of the upper pit), it is about 20 mm long and 13 mm wide.

UM FORM 5 (Forms 2 to 4 are listed under upper pit). The second specimen has toothed edges formed by the placement of five regular notches along both edges, and one notch at the base (Figure 19, B). From Layer 3, it is 22 mm long and 10 mm wide.

CONSIDERATIONS ON THE DATING OF OTHER SITES

Can other sites on the Northern Plains be dated on the basis of results learned at the Old Women's Buffalo Jump? It seems probable that, with reservations, some of them can be.

The main obstacles in attempts to date a site by means of the types of small side-notched points it contains are these: (1) Individual specimens cannot be used. The approach must be statistical. In the upper member of the Old Women's Jump, only one type has a confined distribution—the Washita point. Any other point type could occur over a long time-span. (2) Thus, an adequate series of points, capable of typological analysis in terms of the Old Women's series, must be available. The size of an adequate sample is a dispute best left to statisticians; in actual fact, as at the Women's Jump, it is rarely over 100. If the sample from the jump is not of sufficient size, it has been accepted as reliable here for three main reasons. First, the typological results obtained in the upper pit were confirmed in the main by those from the lower pit. Second, the plotting of individual features, for which large samples were frequently available, revealed clear historical trends. Since the types, as developed, were merely conceived as combinations of individual features, they reflect the same changes in time, if more generalized. Third, to the south and east (if not so far east as Manitoba), similar types of points occur in contexts which often suggest that they are of the same relative age as point types from the Old Women's Jump. (3) However, another difficulty in dating other sites by means of the typology developed at this jump is that published descriptions allow no one-to-one comparison of point types from another series with the Old Women's series. Illustrations are generally helpful, but cannot be relied upon to represent a collection proportionately. It is the proportional relationships of one type to another that will test the reliability of the Old Women's series in the cross-dating of other sites. How far afield the Old Women's series will have chronological implications remains to be tested at varying distances from the jump.

One test can be applied to the Ross Site (Forbis, 1960). This is a camp-site on the banks of the Oldman River, about 65 miles southeast of the Old Women's Jump. The top layer (Ross III) yielded a sample of 77 points of the same general nature as those from the jump. When classified according to the Old Women's typology, they fell into the following categories:

Type	*Number*	*Percentage*
Washita	4	5.2
Pekisko	25	32.4
Paskapoo	23	29.9
Nanton	22	28.6
Lewis	—	——
Irvine	2	2.6
High River	1	1.3

It is clear that the frequencies of various types from Ross III are in close accord with frequencies of types in Layers 1 to 4 at the jump (cf., Table 2). In addition, certain forms restricted to the upper layers at the jump (single side-notched, base notched, skewed base, and unnotched points) also were present in Ross III. The results strongly suggest that Ross III and Layers 1 to 4 of the Old Women's Jump are close to being contemporaneous.

This relative age for the Ross Site fits the interpretation set forth for the probable age of Ross III, of about A.D. 1500–1700 (Forbis, 1960, p. 159). This estimate was postulated on geological evidence; but other independent evidence for the absolute age of Ross III and Layers 1 to 4 of the Women's Jump remains to be secured. Even so, until it is, the Old Women's series may be one of the most accurate chronological indicators that exist for prehistoric times in the area, provided that the qualifications, mentioned above, are observed.

PROJECTILE POINTS FROM THE UPPER PIT, LOWER MEMBER

Because the sample of projectile points from the lower member is insufficient for statistical analysis, valid types cannot be established in the same manner as in the upper member. The points are rather classified by descriptive features and will not be designated as types unless the type has already been named.

BESANT POINTS. Large, in relation to points from the upper member, Besant points are chiefly characterized by shallow corner notches, which produce a broad, flaring stem, almost as wide as the body. The shoulders are straight or sloping. Body edges are almost always convex. Most specimens are bifacially dressed, secondary flake scars replacing the original flake scar. Basal thinning is not common; but basal grinding is general and may be light to heavy. The edges of the stem are similarly dulled.

In length, Besant points range from 25 to 37 mm, and some incomplete specimens probably exceed 40 mm. They are from 17 to 24 mm wide, and from 4 to 7 mm thick. Width at the neck ranges from 14 to 18 mm. The proportion of length to width is generally about 1.5 to 1. Complete specimens range from 1.8 to 4.6 grams, and average 3.4 grams.

Four varieties may be distinguished. Each occupies a different segment of the stratigraphy, and all varieties are possibly in a developmental line (Figure 15).

Variety 1 (Figure 14, A) is distinguished by an outline similar to Irvine or Nanton points, which may be derived from Besant points. The base, slightly concave, is nearly as wide as the body, and the basal corners are rounded. The proportion of length to width tends to be about 2 to 1. The two points originated in Layers 15 and 16.

Variety 2 (Figure 14, D, E) is similar to Variety 1 except that the length-width ratio is the usual 1.5 to 1, and the base tends to be slightly convex. The two specimens are from Layers 16 and 17.

Variety 3 (Figure 14, B, C) includes specimens smaller and thinner than either of the foregoing groups, and differs from Variety 2 mainly in that the base is straight or concave. Three specimens are from Layers 16 and 17; the fourth, which is incomplete, may or may not have a straight or concave base. It is from the lower half of combined Layers 18 to 21.

Variety 4 (Figure 14, F, G) is comprised of four specimens with generally sharp and straight shoulders. Distinctively, the basal corner tends to be sharp, rather than rounded as among other varieties. The base is slightly convex. Stratigraphically, they occur in Layers 17 through 22, usually in the earlier horizon.

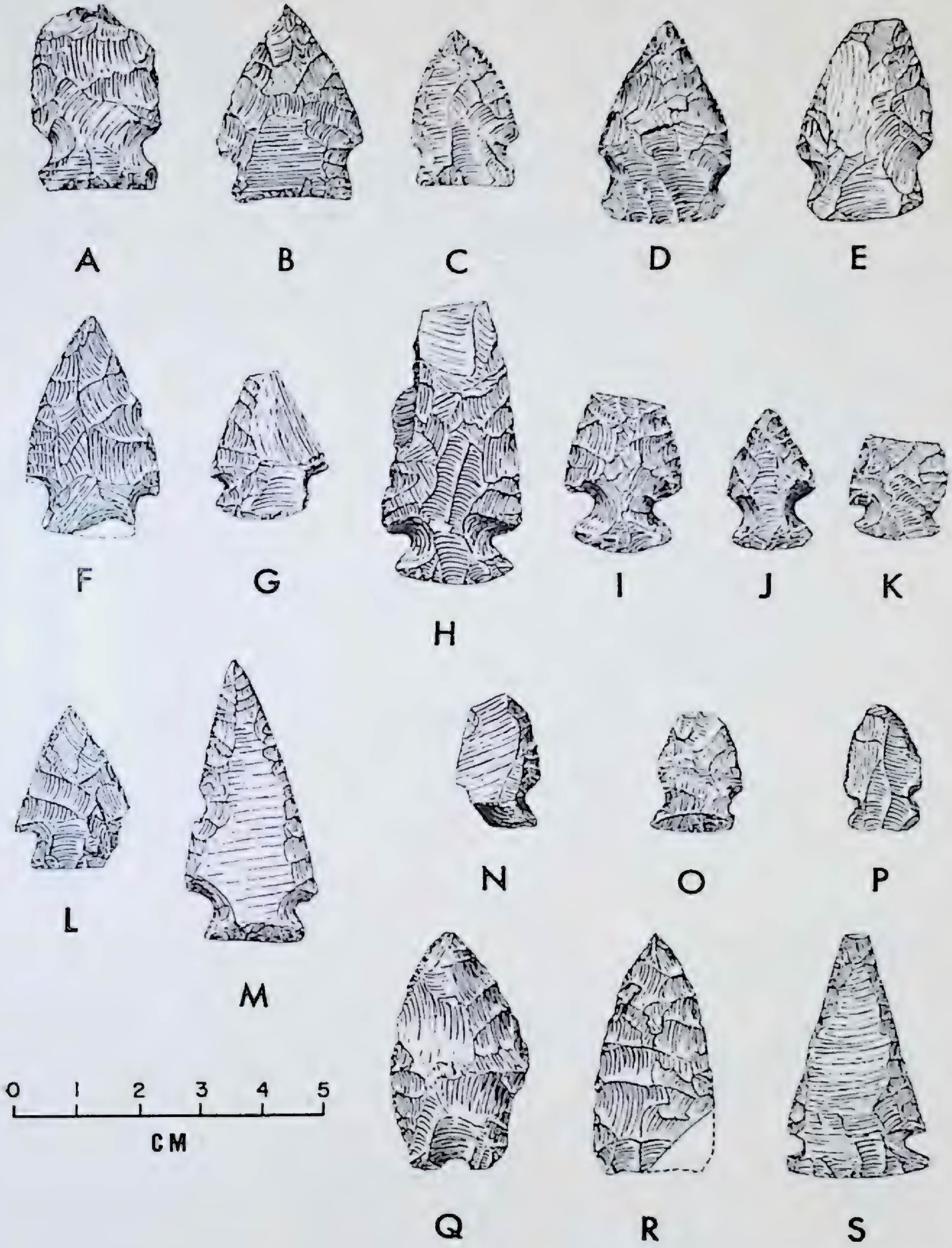


FIGURE 14. Drawings of projectile points from the upper pit, lower member. A–G, Besant; H,I, Style LM-1; J,K, Style LM-2; L,M, Style LM-3; N–P, Nanton; Q, Form LM-1; R, Form LM-2; S, Ensor.

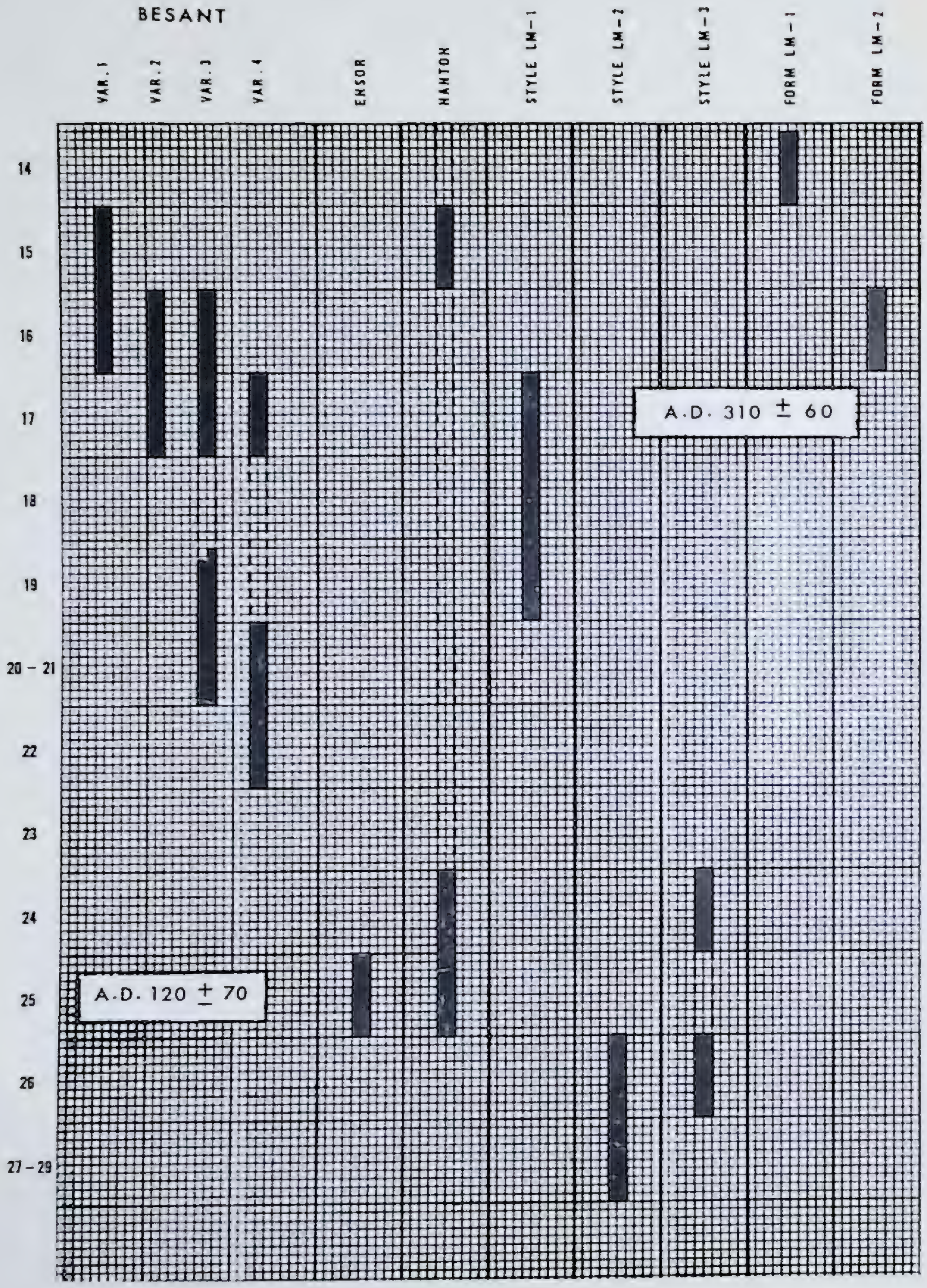


Figure 15. Distribution of projectile points by layer from the upper pit, lower member.

Comments. All varieties appear at Mortlach and some at the Long Creek Site in Saskatchewan. Their stratigraphic position at these localities does little to confirm their suggested temporal relationship at the Women's Jump, and a much larger sample would be required to verify the relationship.

At Mortlach, the Besant 4B layer was dated by radiocarbon at A. D. 377±325 (Wettlaufer, 1960, p. 114). This is in agreement with a date of A.D. 310±60 for Layer 17 of the Old Women's Buffalo Jump. Wettlaufer's estimate that the Besant "Culture" persisted from A.D. 36 to 1287 seems far too long, especially in view of the sequence at the jump, where the small-point tradition is thought to have started about A.D. 600. A probable date for the end of the period characterized by Besant points is A.D. 500–600.

Besant points may be related to Anderson corner-notched points, described by MacNeish for Manitoba and estimated to extend in time from 1500 B.C. to A.D. 500 (1958, pp. 101–102). Besant points which occur in surface sites in southern Alberta are apparently found in some quantity in Montana, particularly in buffalo pounding sites, which are thought there to represent an older horizon than buffalo jumps (Shumate, 1950, p. 8).

ENSOR POINTS (Figure 14, S). A large side-notched point has absolutely straight body edges which formerly met at a sharp tip. Width at the base is equal to the maximum width of the body; the height of the basal edge is less than notch width. The base, which is not smoothed, is gently convex. One face is dressed with irregular flake scars; the other is retouched at the edges only. In length the point was about 45 mm; in width, 22 mm; in weight, 3.9 grams.

Comments. The specimen is from Layer 25, which has a radiocarbon date of A.D. 120±70. It appears to have no cognate forms in the Northern Plains. It does, however, occur in Texas and adjacent regions, where it was named. Ensor points are thought there to range from 1000 or 2000 B.C. to A.D. 500 or 1000 (Shum and Krieger, 1954, p. 422; *see* Figure 90, esp. DD and EE).

NANTON POINTS. Four small points in the lower member (not including Style LM-2) belong to the Nanton type (q.v.). In each case, the base width is equal to body width, and the height of the basal edge is less than notch width (Figure 14, N–P). Two have rounded basal edges. The others have sharp basal corners. One specimen is bifacially dressed; the others are flakes which have merely been trimmed at the edges. They range in length from 21 to 28 mm and in width from 12 to 15 mm. Neck width (8–11 mm) also corresponds to points from the upper member.

Comments. One specimen is from Layer 15, where it might be expected. Three specimens, however, are from the early layers 24 and 25, dated at A.D. 120±70. They could be intrusive, but they are rather distinctive for their poor quality of chipping and for the fact that the basal corner is often sharp, a trait rare among Nanton points and possibly a relatively early one. Small points have been found before in contexts of predominantly large points (the Pelican Lake component, Wettlaufer, 1955, p. 55).

STYLE LM-1 (Figure 14, H, I) points are corner-notched with convex bases and flaring stems always narrower than the body. Basal corners tend to be rounded and the shoulders straight. Lateral edges are slightly convex, meeting at a fairly sharp tip. The points are well-made, even though not always bifacially dressed. Two of the five are dressed unifacially and retouched on the edges of the other face. Specimens from the Old Women's Jump are always at least 35 mm in length, and one may have exceeded 50 mm in length. Maximum width ranges from 20 to 23 mm; thickness varies from 4 to 5 mm. The ratio of length to width is generally about 2:1; one specimen approaches 3:1. Width at the neck is from 10 to 15 mm. In weight, they range from 2.6 to 5.7 grams, averaging 4.0 grams.

Comments. Style LM-1 points are found continuously through Layers 17 to 19 in the Women's Jump, and all these layers may be part of the same physical unit (*see* Stratigraphy). Their position indicates a contemporaneity with Besant points, and the same radiocarbon age (A.D. 310±60) applies to both. The two kinds of points were found together in the Mortlach site (Besant 4A), although Wettlaufer has there assumed the mixture to be due to intrusion (1955, p. 44). Style LM-1 points are identical in outline to Pelican Lake points from the Mortlach Site, dated by radiocarbon from Long Creek at 293±100 B.C., but W. J. Mayer-Oakes, who examined the specimens from the Women's Jump, does not consider them the same. Pelican Lake points have a finer "feel." Mulloy has illustrated similar points from Pictograph Cave II, in Montana (1958, Figure 6, Nos. 21, 22, 26); they belong to the Late Middle Prehistoric, estimated to range from the time of Christ to A.D. 500. Mulloy has grouped the points from the Billings (Montana) Bison Trap with those from Pictograph Cave II and has personally informed the writer that some of them resemble Style LM-1 points.

STYLE LM-2 points (Figure 14, J, K) are identical to LM-1 points in outline and similar in other features, but they do not exceed 30 mm in length, 20 mm in width, or 1.5 grams in weight. One specimen (Figure 14, K) could be classified as a High River point (q.v.).

Comments. While they might be expected to occur high in the lower member, owing to their resemblances to points of the small-point tradition, the two LM-2 points are among the earliest at the Jump, being from Layers 26 and 28. Thus they are earlier than A.D. 120±70, the radiocarbon age for Layer 25.

At the Mortlach Site, Wettlaufer found similar, but not identical, small points in the Pelican Lake component with larger specimens. Pelican Lake points bear a generic resemblance to LM-1 and LM-2, and the dating for Pelican Lake points at Long Creek is 293±100 B.C., which is not far out of line with their age at the Women's Jump. At both Mortlach and the Women's Jump, the small points of the generalized Pelican Lake horizon are separated from the small-point tradition (Layers 1 to 14) by strata containing only large (dart?) points.

STYLE LM-3 points (Figure 14, L, M) have straight lateral edges meeting at a sharp tip. The sharply pointed shoulders, created by corner notching, run straight inward to the neck, and the stem flares out to meet the straight base at sharp corners. The base, which is ground, is always narrower than the body. LM-3 points may be unifacially dressed (and retouched at the edges of the other face) or bifacially dressed. Of two specimens, one is 47 mm long, 22 mm wide, and weighs 4.0 grams; the other is 27 by 18 mm and weighs 2.0 grams. Both are made of Knife River flint.

Comments. The points are from Layers 24 and 26, which probably belong to the same depositional unit (*see* Stratigraphy). The dating for Layer 25 is A.D. 120±70.

There appear to be no comparable specimens mentioned in the literature of the Northern Plains. Possibly, LM-3 points developed into Besant (Variety 4), from which they differ in a few respects: (1) the body edges are straight rather than curved; (2) the stem is narrower in relation to the body; and (3) the base is straight rather than curved. LM-3 points may be only 50 to 100 years older than the earliest Besant points.

POINT FORMS. Single specimens which cannot reasonably be grouped with others are known here as *forms*, following Daugherty's usage (1955, p. 233). His terminology has been used above, in designating as *styles*, groups of specimens that have no established geographical or historical range and therefore do not qualify as types.

FORM LM-1 (Figure 14, Q) is a lanceolate point, bulging on one edge and notched at the base. The effect of the bulge is to create a shoulder and thus define a stem. The stem is roughly parallel-sided, and the base is straight. The point is 39 mm long, 22 mm wide, 7 mm thick, and weighs 7.7 grams.

Comments. Except for the shoulder, the point would fit into the McKean type as defined by Wheeler (1952, pp. 45–50). Or, if the other edge were symmetrically shouldered, it could belong to the Duncan type (Wheeler, 1954, pp. 7–8). Both types, however, are considered to be much more ancient than the age for Layer 14, where the point originated.

FORM LM-2 is a large, triangular specimen with no stem, from Layer 16 (Figure 14, R). It has convex body edges which meet at a sharp tip and meet the base on the round. One face of the point is bifacially dressed, the other trimmed at the edges only. It is 40 mm long, 20 mm wide, and weighs 3.3 grams.

Comments. The specimen has few diagnostic features, but it seems comparable to a specimen from the Besant layer of the Mortlach Site (Wettlaufer, 1955, Pl. 7, No. 6), and its stratigraphic position in both sites would suggest they belong together. It also is similar to a point from the "Oxbow Culture" at Long Creek (Wettlaufer 1960, Pl. 18, No. 5), but that point has a concave base. The Oxbow component is about 1000 years earlier (according to radiocarbon dating) than Layer 16.

PROJECTILE POINTS FROM THE LOWER PIT, LOWER MEMBER

Of twelve projectile points, three are fragments of no diagnostic value. Types which occurred in the upper pit as well are—Besant, Style LM-2, Style LM-3, and Nanton. Comments on these types are given under appropriate headings above. Two remaining specimens are unique.

BESANT POINTS (Figure 16, A–C). Three specimens belong descriptively to the Besant type, variety 2. They range from 29 to 31 mm in length, from 18 to 20 mm in width, from 15 to 16 mm in neck width, and from 4 to 5 mm in thickness. They are from Layers 9, 10, and 11, which very probably equate approximately with the layers (15 to 22) in the upper pit, where Besant points form a prominent element.

A single fragmentary specimen probably belongs to variety 4 of the Besant type (Figure 16, C). It is 36 mm long, 20 mm wide, and 5 mm thick, with a neck width of 13 mm. It is from Layer 10.

STYLE LM-2. The basal fragment in this style from the lower pit is almost exactly identical in size and shape to a specimen illustrated from the upper pit (Figure 14, K). There, such specimens were found at a greater depth than Besant points; but the point from the lower pit originated in Layer 11, in an early layer contemporaneous with Besant points. No artifacts of any description were recovered in the lower pit below Layer 11.

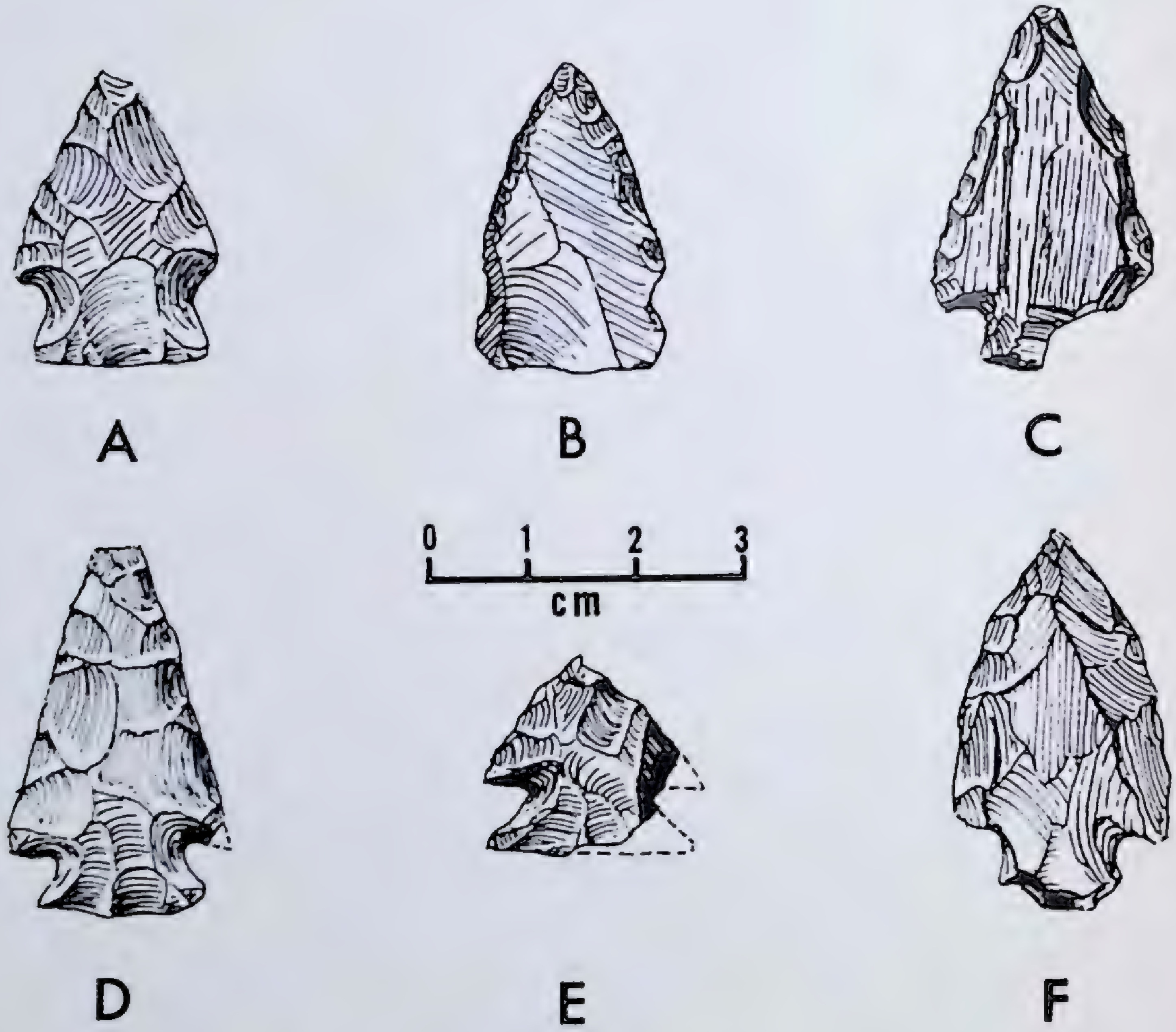


Figure 16. Drawings of projectile points from the lower pit, lower member. A–C, Besant; D, Style LM-3; E, Form LM-3; F, Form LM-4.

STYLE LM-3. One specimen, almost barbed, has the straight lateral edges and the flaring stem which characterize LM-3 points from the upper pit (Figure 16, D). The specimen from the lower pit is somewhat cruder in that it is made of quartzite. It was 28 mm long, 22 mm wide, 5 mm thick, with a width at the notches of 14 mm. In the upper pit, LM-3 points occupied a very early position in the sequence, but the specimen from the lower pit was in the topmost layer (9) of the lower member, suggesting a relatively recent age.

NANTON POINTS. A point from Layer 11 of the lower pit is of the Nanton type. This type is especially common in the upper member but also occurs in the lower member of the upper pit, where it also appears to be of great antiquity. The point is 23 mm long and 14 mm wide.

POINT FORMS. Two specimens have no counterparts among other specimens from the jump and do not appear to fall into types as recognized elsewhere. They are in addition to two point forms from the lower member of the upper pit.

FORM LM-3. One specimen, broader than it is long, has deep corner notches which give a sharply flaring appearance to the stem (Figure 16, E). The base and lateral edges are straight, as is the shoulder. From Layer 10, it is 18 mm long, over 20 mm wide, and 4 mm thick.

FORM LM-4 is a thin-stemmed point with straight shoulders and convex body edges (Figure 16, F). The bulbous stem may be broken; it is irregular in outline. The point is 37 mm long, 20 mm wide, and 4 mm thick.

Artifacts Other than Projectile Points from the Upper Pit

BIFACES

Awl. The single specimen classified as an awl is a small thin flake of obsidian which originated in Layer 4 (Figure 17, A). The flake is worked only at the fragile tip; the type of retouch suggests use rather than deliberate flaking. It is identical to some specimens from the Ross site and apparently contemporaneous with them (*see* p. 105). Such awls may be temporally diagnostic. It is 19 mm long and 14 mm wide.

Pointed bifaces. While varying considerably in size and finish, four pointed bifaces are characterized by a pointed tip, usually somewhat blunted. None was recovered in the productive upper layers. One specimen, from an arbitrary 36- to 48-inch level in square H-O, is made of a light, banded yellow and pink chert (Figure 17, B). Roughly leaf-shaped, it tends to be alternately bevelled, and both faces are thoroughly, if irregularly, dressed. One edge, near the base, bears the suggestion of a notch. It is 60 mm long and 28 mm wide. The second specimen, from Layer 8, is made of grey chert (Figure 17, C). Essentially triangular in shape, its lateral edges bulge slightly. Both faces are dressed, and the lateral edges are carefully chipped. The base, however, is irregular in outline and completely unmodified. It is 54 mm long and 38 mm wide. A third specimen, from Layer 9, is a narrow sliver of dark petrified wood (Figure 17, D). One of

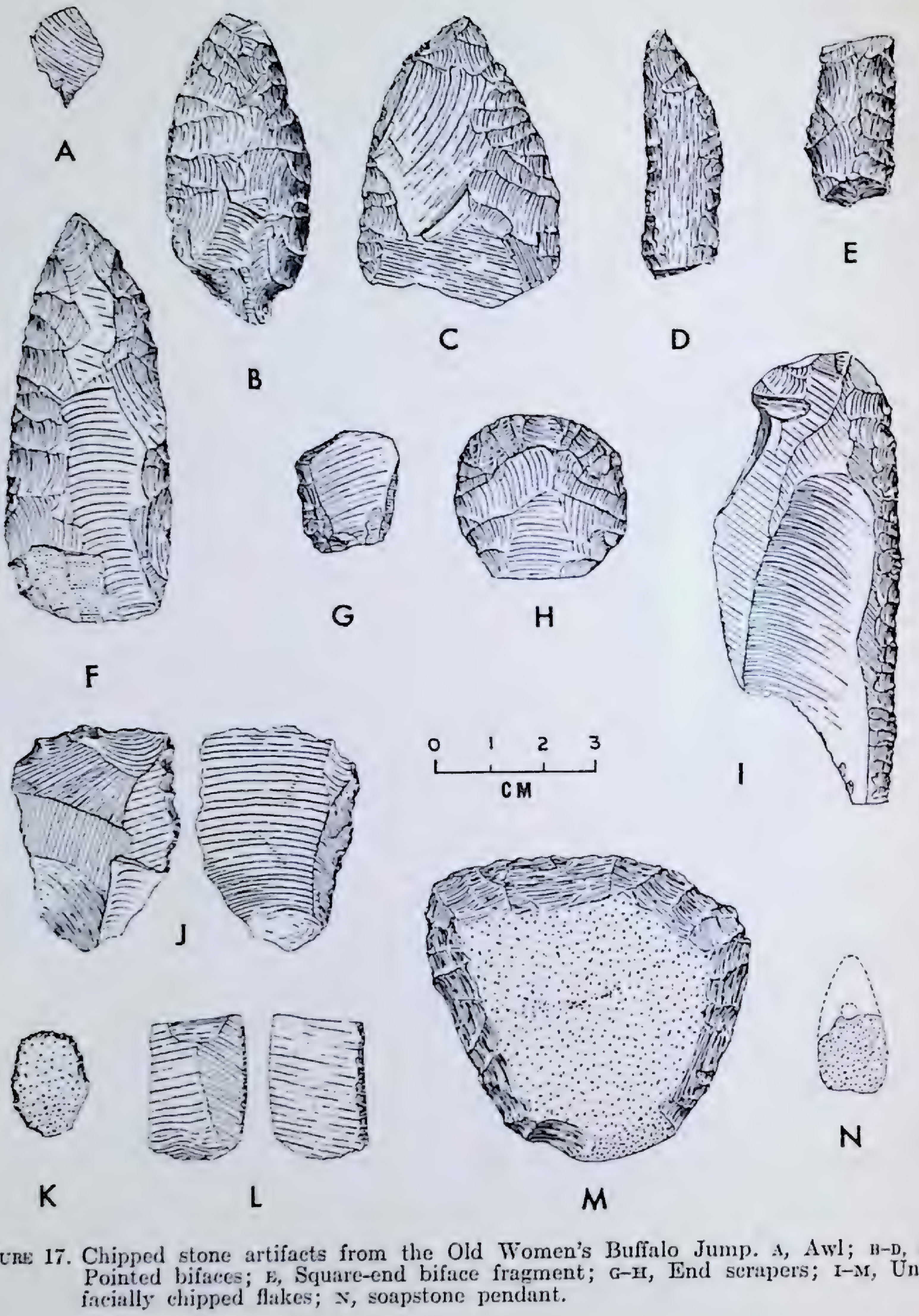


Figure 17. Chipped stone artifacts from the Old Women's Buffalo Jump. A, Awl; B–D, F, Pointed bifaces; E, Square-end biface fragment; G–H, End scrapers; I–M, Unifacially chipped flakes; N, soapstone pendant.

its lateral edges is convex, the other straight to concave. The base is cleanly broken. Chipping is limited to the edges of both faces. It is 48 mm long and 14 mm wide.

The fourth and final specimen was found in Layer 23 of the lower member (Figure 17, F). It is a large, lanceolate specimen essentially plano-convex in cross-section despite bifacial dressing. The upper face, in addition to being fluted, is relatively steep-sided, producing a bevelled effect and suggesting that the artifact was used in scraping rather than in cutting. Made of moss jasper, it is 80 mm long and 33 mm wide.

Biface base fragments. Four fragments of small, narrow bifaces are characterized by somewhat squared bases. Tips are missing (Figure 17, E). Except for one, which resembles the base of a McKean point, they are thick and, despite bifacial dressing, are inclined to be plano-convex in cross-section. They are 15 to 18 mm wide and 7 to 8 mm thick. One specimen is from a combined layer 4–5–6; the remainder belongs either in Layer 3 or 4.

Bifacially chipped flakes and fragments. Most bifacially chipped flakes and fragments are not distinctive. They comprise a wide range of materials. The flakes have no geometric form; the fragments cannot be identified with complete specimens from the layers in which they occurred. Fragments are usually tips or midsections of artifacts larger than projectile points.

It is noteworthy that bifacially chipped flakes and fragments are limited to the upper member, while unifacially chipped flakes are scattered through both the upper and lower members.

UNIFACES

End scrapers. In the upper pit, only three end scrapers were recovered, confirming the inference that ordinary camping activities at the jump were negligible. Two scrapers, from Layers 1 and 4 are poorly made. One broken specimen retains the cortex on the upper surface and is broken; the other is more prominently chipped along one edge than at the end (Figure 17, G). A discoidal outline distinguishes the third scraper, from Layer 14 (Figure 17, H). Both lateral edges are worked; but steep bevelling is limited to one end. The other end shows a clean but well-worn break. Made of basalt, it is 30 to 35 mm in diameter.

Unifacially chipped flakes and fragments. Although fewer in number, unifacially chipped flakes are more widely distributed than bifacial flakes in the sequence at the Old Women's Buffalo Jump, and they are generally larger. Undistinctive flakes occur in Layers 3, 5, 11, 17, 18, 20, 21, and 22, represented by single specimens except in Layer 5, where two occur. Most are made of quartzite and petrified wood.

Five flakes are unusual and, possibly, of some diagnostic value. The first is long and thin, chipped to a bevel along one straight edge (Figure 17, I). Apparently it had a point, perhaps a drilling tip, emerging from one end, but that is now broken. Of jasper, it is from Layer 3; it is 90 mm long and 36 mm wide. The second, a rough flake of quartzite from Layer 7, is alternately bevelled and thus not a true uniface (Figure 17, J). One end is also crudely bevelled. It is 45 mm long and 33 mm wide. A small ovoid spall of basalt from Layer 14 is lightly chipped around much of the margin, except at the bulb of percussion and adjacent region (Figure 17, K). It is 20 mm long and 15 mm wide. Finally, two flakes from Layer 22 are distinctive. One forms a small rectangle, alternately bevelled, measuring 27 mm by 19 mm (Figure 17, L). The other, a large, thin triangular flake of quartzite, bevelled along all edges except at the bulb of percussion (Figure 17, M), is some 60 mm long and as wide.

HEAVY STONE TOOLS

For the most part, heavy stone tools from the Old Women's Jump are crudely made, and, in some cases, they are doubtful artifacts.

Notched choppers are, however, unquestionably products of human manufacture. They are flat, waterworn cobbles, elliptical to rectangular in outline (Figure 18, A). Notches are pecked into both edges, and a shallow groove may or may not connect the notches. Three of the five specimens are incomplete. Only one end appears to have been chipped, either unifacially or bifacially, in order to produce a working blade. Aside from these worked surfaces, the waterworn cortex remains intact. They range from some 12 to 17 cm in length, 10 to 12 cm in width, and 3 to 4 cm in thickness. All are made of hard, durable stone.

Four specimens are known to be from Layer 13, one from near a possible hearth. The fifth came from an arbitrary 60- to 66-inch level in Square I-I, a level which may well correspond to Layer 13.

Choppers. Seventeen conventional choppers occur sporadically through the sequence, from Layer 26 to the surface (Figure 18, B). Made of various materials, they are fieldstones which have been unifacially bevelled by percussion flaking at one end. The leading edge is step flaked, almost certainly as a result of breaking bones for brain and marrow.

The stones are moderately heavy but are well adapted to use with one hand. They are generally some 13 cm long, 10 cm wide, and 6 cm thick. Two specimens from Layer 10 are markedly smaller; two from Layer 14 are considerably larger than average. The surface, aside from the chipped area, is ordinarily a waterworn cortex. Exfoliation occurs on two specimens from Layers 3 and 6. The single chopper from Layer 26 is a waterworn quartzite pebble, broken naturally to a desired shape and varnished by nature to a gloss before it was selected to serve as an artifact. The flaked areas are not varnished. A lone specimen from Layers 20–21 is an angular, rectangular chunk, chipped so that vestiges remain of the original waterworn cortex. Two specimens (from Layers 1–2 and 3) are long, thin slabs apparently designed to be held around the middle rather than at the head.

Aberrant choppers. Five choppers vary from the norm in that bifacial chipping produced the leading edge. One or two may only be fire-broken rocks. These angular stones commonly lack much of their original waterworn cortex. They correspond in size to normal choppers, and in distribution they are similar, ranging from Layer 25 to the surface (although they are absent in the intermediate zones).

Hammerstones. Six hammerstones, from Layers 1, 3, 13, 18, and 24, are characterized by a pecked area that mars the smooth cortex of these

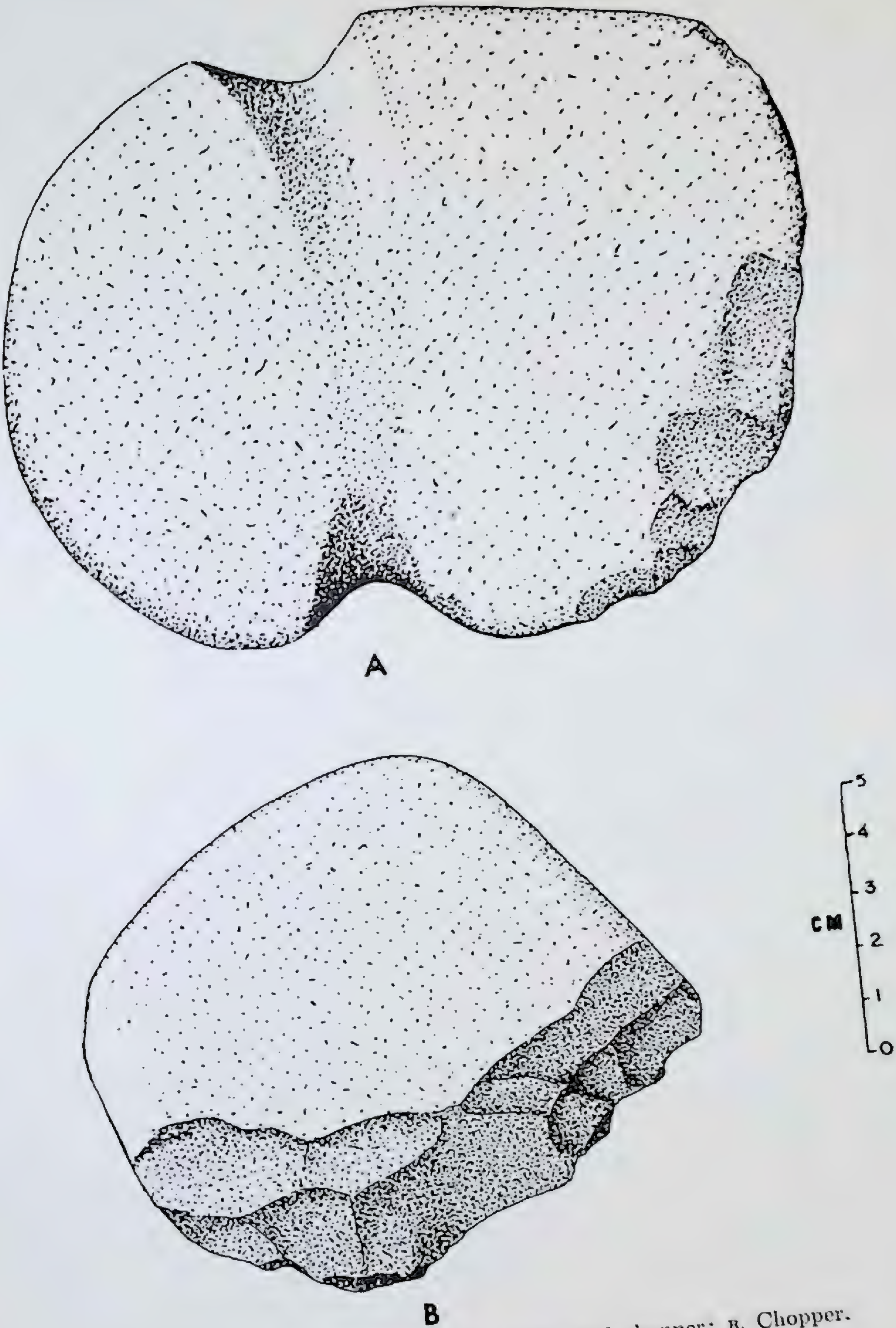


FIGURE 18. Heavy stone tools. A, Notched chopper; B, Chopper.

stream pebbles. Usually the pecked area occurs at one end only, and it is distinct from the cortex. In one case (Layer 18), the pecked surface is a band extending from one end round one-quarter of the circumference. These hard rock specimens (quartzite and probably granite) are generally smaller than ordinary choppers by about one or two centimetres in all dimensions.

GROUND STONE

Pendant. A small, thin, broken tablet of soapstone, appears to have been roughly triangular in outline (Figure 17, N). Both faces are worn smooth. Traces of a perforation remain at the broken end. From Layer 3, the specimen is 13 mm wide and less than one mm thick.

MINERALS

Ochre. Two small lumps of ochre appeared in Layer 4. One is a compact orange powder (limonite) which leaves an orange streak. The other is a red hematitic sandstone which crumbles if pressure is applied; it leaves no streak.

BONE

In all the bone sifted at the Old Women's Buffalo Jump, only one specimen attains even doubtful status as a bone artifact. It is possibly a splinter awl which comes asymmetrically to a point at one end. Made of rib, all the cancellous tissue has been removed, and the edges are rounded. From Layers 1–2, it is 91 mm long, 17 mm wide, and 4 mm thick.

POTTERY

Work in clay from the bone deposit was relatively rare, stressing again the fact that the jump was scarcely used for ordinary camping purposes. Only one sherd is from a known layer (5, in Square E–0). The remaining three were excavated from one of the most easterly squares (I–0), where there was no physical means to recognize the layers as known from the more central portions of the bone deposit. The sherds were found in the 24- to 36-inch level, about the distance that Layer 5 lies under the surface. However, as the sherds are obviously of the same pot, they may all safely be attributed to Layer 5.

Temper consists of a moderate amount of angular particles of quartz, mica, and probably feldspar, suggesting crushed granite. Some particles are as much as 4 mm across; but many more are almost microscopic. The temper is well mixed with the paste, a fact which in some measure must account for the compact texture of the sherds. In contrast with most pottery of the area, there is little tendency toward lamination, and the sherds do not crumble easily.

In colour the sherds are predominantly a very dark grey both on the interior and exterior as well as in the core. The exterior, however, may be a medium dark grey with strong overtones of brown; where this occurs, the core may be correspondingly light, grading into dark grey toward the centre. The interiors are all coated with black carbonaceous material. Hardness appears to be over 3 but less than 4.

The exteriors appear to be cord-roughened, although there is no definite indication of a twisted cord. The impressions, which are always vertical, have been smoothed over to obliterate high ridges. The low ridges describe a fairly regular pattern and are about 4 mm apart; no basal sherds are present, but on the present sherds, over-all treatment is uniform.

As for form, the lip is flattened but rounded at the edges; on the exterior it meets the rim at an angle of slightly more than 105 degrees, and there is a thickening on the interior. The lip is 8 to 9 mm wide. The neck, nearly straight with a slight incurving, slopes inward from the shoulder so that the mouth is constricted. The shoulder is the plane of greatest diameter. It is almost carinate, and shoulder sherds measure 16 to 18 mm in thickness. Body sherds are about 10 mm thick. The shape of the body cannot be determined from them. It seems clear that the vessel is a jar, but whether the base is pointed or globular cannot be ascertained.

Two forms of decoration occur. The shoulder is punched by fingernail every 8 mm. The rim, where it meets the lip, is treated in roughly the same manner, and although the punctations are not nearly so deep, they are more frequent (every 6 mm). In addition to this form of decoration, a zone between the lip and shoulder has been impressed vertically with a cord-wrapped rod, the cuts being about 2 to 3 mm apart. In one case at least, a pair of vertical wrapped-rod impressions, separated by a distance of some 2 mm, run parallel to each other.

While the potsherds are not exactly identical to others known from southern Alberta, they correspond closely to some pottery from the Ross Site (Forbis, 1960, pp. 122–126, Plate VII, Figure 3). They clearly belong to Ethridge ware, as described by A. Kehoe (1959, pp. 238–240). Except for the presence of wrapped rod impressions, known to Ethridge ware, they parallel Ross I pottery in surface treatment. Vessels of similar shape were recovered in the top layer of the Ross Site (III), where an identical method of rim and shoulder decoration is known.

Artifacts Other than Projectile Points from the Lower Pit

BIFACES

Drill. A fragmentary specimen from Layers 1–2 appears to have been a drill (Figure 19, C). The form of a broken tang, ovoid in cross-section, suggests the broken point of a drill bit. One edge, curving in toward the break, has been retouched by use.

Pointed biface. The single specimen is apparently broken but is almost identical in size and shape to one specimen from Layer 9 of the upper pit (cf., Figure 17, D). The biface from the lower pit is from Layer 5, stratigraphically equivalent to the bottom part of upper pit Layers 4 to 10; thus the specimens are similar in age.

Semilunar bifaces. Two elongated specimens are straight along one edge and convex along the other (Figure 19, A). The complete specimen, from Layers 7–8, may be an example of the pointed bifaces discussed above, but it is much thinner (4 mm compared to 7 mm). It is 55 mm long,

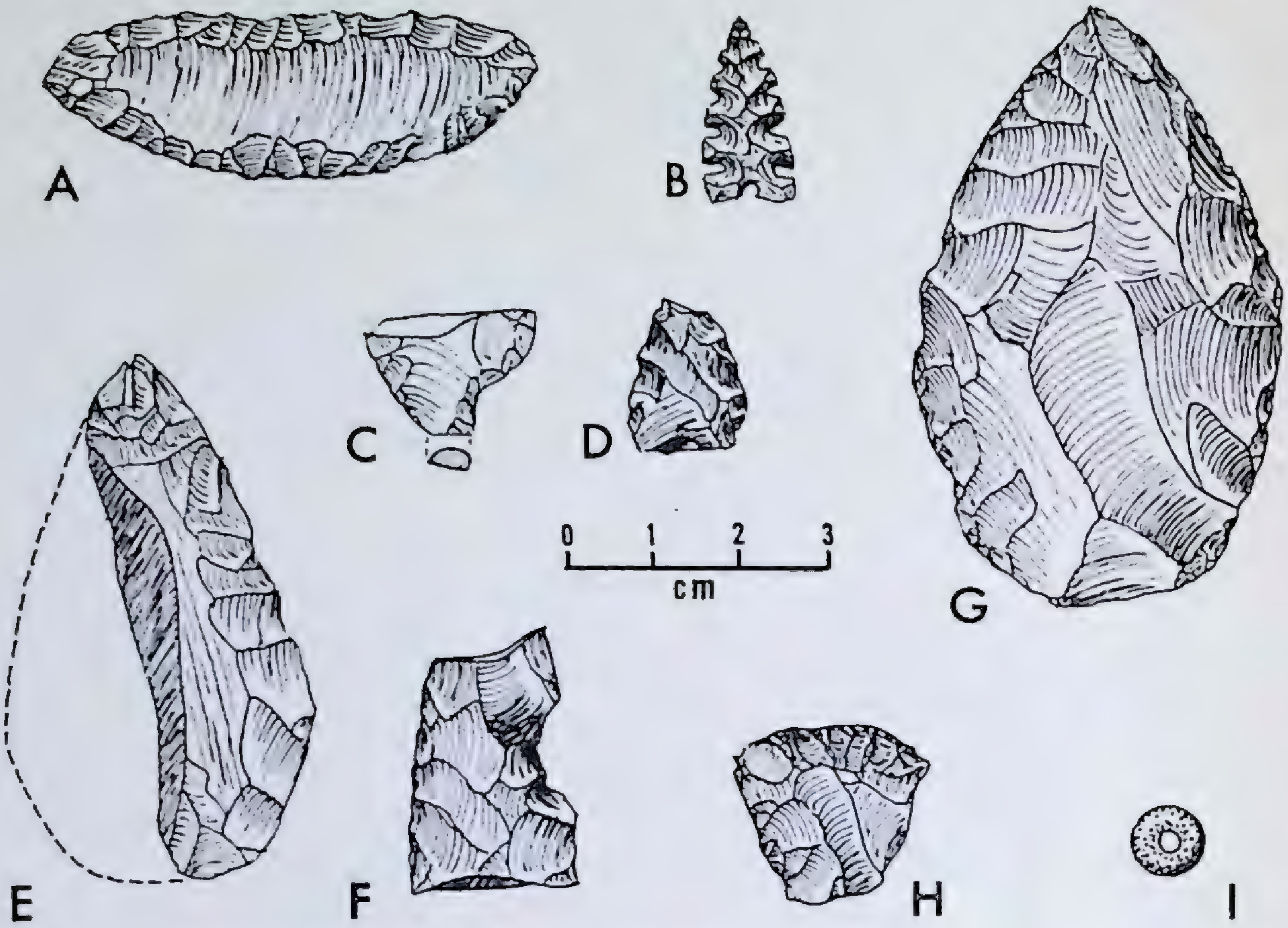


FIGURE 19. Drawings of stone artifacts from the lower pit. A, Semilunar biface; B, Form UM-5 point; C, Drill (?); D, Form UM-1 point; E, F, Biface fragments; G, Pointed uniface; H, End scraper; I, bead.

and 18 mm wide. The fragmentary specimen, from Layer 7, is much thicker. Layers 7–8 of the lower pit would be equivalent to Layers 13–14 in the upper pit.

Biface flakes and fragments from the lower pit are not significantly different from those of the upper pit. Most are of petrified wood and extend from Layers 1 to 7, a range included by Layers 1 to 14 of the upper pit where all biface flakes and fragments were also limited to the upper member.

One fragment suggests the outline of a broad, leaf-shaped knife, some 60 mm long and 30 mm wide (Figure 19, E). It is from Layers 1–2. Another, possibly part of the blade of a large point, has been reworked along one edge to form a spokeshave (Figure 19, F). It is from Layer 7.

UNIFACES

End scraper (Figure 19, H). The single end scraper, from Layer 1, is not unusual in form. The scraping end is convex; the straight edges contract to meet a short, square base, which is the only edge not retouched by use. The under surface has a few, apparently inconsequential, flake scars. Its width and length are both 20 mm. Thickness is 7 mm.

Pointed uniface (Figure 19, G). A distinctive quartzite specimen is leaf-shaped in outline and pointed at one end. Irregular flake scars cover the steep upper surface; the edges are finely retouched. The flat under surface is marred by a few small, and apparently inconsequential, flake scars. The specimen is 70 mm long, 40 mm wide, and 14 mm thick, and is from Layer 10.

Unifacially chipped flakes and fragments are artifacts of little diagnostic value. They are chance flakes which have been chipped along one or more edges to no obviously preconceived pattern. The 16 specimens range from Layers 1 through 10, and thus extend into the lower member, as in the upper pit.

HEAVY STONE TOOLS

Hammerstones. Two specimens from the lower pit are descriptively no different from those of the upper pit, being merely waterworn pebbles pecked at one end. They are from Layers 1–2 and 11, and are thus similar in distribution to those from the upper pit.

Choppers were not recognized as artifacts by some sorters, and it is quite likely that some were discarded during the screening operation. The single specimen saved, from Layer 3 (equivalent to the same layer in the upper pit), is indistinguishable from specimens from the upper pit.

Smoother. A large, thin rectangular flake of petrified wood has been chipped bifacially at either end to form a straight edge. At one end, particularly, the chipped area has been evenly worn down, perhaps as a result of scraping. The lateral edges are rounded, perhaps by erosion. From Layers 1 to 2, the specimen is 77 mm long, 35 mm wide, and 11 mm thick.

GROUND STONE

Bead. A steatite bead from Layers 1–2 is globular in form and is flattened on both sides (Figure 19, I). The perforation, 2.5 mm across, is perfectly uniform in diameter. Almost black, the bead is 9 mm in diameter and 6 mm thick.

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A DISTRIBUTIONAL STUDY OF SOME ARCHAIC TRAITS IN SOUTHERN ONTARIO[1]

By J. V. Wright

For nearly fifty years, artifacts attributable to the Archaic Pattern have been found throughout Southern Ontario, and though many of these "relics" were certainly re-lost to archaeology, a percentage did reach the Royal Ontario Museum. It is this collection that provides the raw data for this paper.

A number of objections may be raised regarding the validity of interpretations derived from such museum collections. The time factor is controlled only inasmuch as the traits examined are thought to be diagnostic of a certain period. Any consideration of a complex of traits is prohibited by the nature of the sample. Quantitative data are also modified by an aesthetic factor which will influence the types of artifacts most likely to find their way to a museum. And, finally, the problem arises whether or not the collection is representative of the area.

Despite these objections, an attempt was made to examine the Archaic materials in the Museum collection from a distributional and classificatory point of view. It was initially hoped that such an approach would, in the absence of excavated data, throw some light on the general picture of the Archaic occupation of Southern Ontario and the relationship of this area to the rest of the Northeast. It should be emphasized that the findings of the study will be subject to reinterpretation with the advent of future excavations. Indeed, it would be surprising if the vagaries to which the basic data have been subjected do not eventually express themselves in some concrete form. It is still maintained, however, that some of the broader streams of influence upon the Archaic peoples of Southern Ontario may be reflected by means of a distributional and classificatory study of a museum collection. These influences, in turn, may be useful in understanding certain general trends within the various complexes which make up the Eastern Archaic.

The method employed consisted of isolating from the collection all artifacts that were regarded as diagnostic of the Northeastern Archaic Pattern. These artifacts were placed into categories and subdivided into classes on the basis of form. Each category and its constituent classes were then plotted on a distribution map. For various reasons, only a restricted number of Archaic traits could be used in the study. Bone and shell artifacts were excluded by their scarcity in the sample. Typological overlaps between the Archaic and Woodland patterns with regard to chipped stone projectile points and the lack of a reliable point typology for the area prevented the use of such specimens in the study. As a number of categories of artifacts, such as scrapers, appear to possess interpretative value in a quantitative rather than a qualitative sense, they were, therefore, omitted.

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[1] The writer is grateful to Mr. Kenneth Kidd, Curator of the Department of Ethnology, Royal Ontario Museum of Archaeology, for allowing the examination of the Museum collection. The suggestions of the following people who read the paper in its various stages of completion are also gratefully acknowledged: Dr. D. A. Baerreis, University of Wisconsin; Dr. J. N. Emerson, University of Toronto; Dr. R. S. MacNeish, National Museum of Canada; Dr. William J. Mayer-Oakes, University of Oklahoma; Dr. William A. Ritchie, New York State Museum and Science Service; and Mr. William E. Taylor, Jr., National Museum of Canada.

The gouge, bannerstone, ground slate projectile point, ground slate bayonet, plummet, semilunar blade, and full-grooved axe are regarded as Archaic traits since they are believed to occur exclusively within this pattern (Ritchie, 1944; Mayer-Oakes, 1955). The full-grooved axe represented the only artifact examined that is not known to occur within the Laurentian Aspect (Ritchie, 1944). The remaining traits, however, have an occurrence beyond the specific complex known as Laurentian. For this reason, the term "Laurentian Aspect" has been avoided when treating individual traits. Instead, the broader units of Boreal Archaic or Eastern Archaic are used here. There is little doubt that much of the pertinent Southern Ontario material bears a close relationship to the Laurentian Aspect as defined by Ritchie (1940, 1944), but it is felt that such designation would be premature until excavated sites in Southern Ontario produce an associated complex of traits which can be utilized for specific spatial and temporal comparisons. It is relevant to note that recently the term "Laurentian" has taken on a dual meaning. In one sense it refers to a specific complex of traits recovered from excavated and unexcavated sites located, for the most part, near the south shore of Lake Ontario and the upper Hudson River Valley of New York State. Within these two geographical areas the Brewerton Focus and the Vosburg Focus were established (Ritchie, 1938, 1944, 1951). In the second sense, the term has also come to mean a generalized northern Archaic Pattern widespread throughout northeastern North America and, in this sense, is a synonym for what Byers (1959) calls the Boreal Archaic. The extension of the term revolves around the philosophical problem of how far the classificatory device called "Aspect" can be stretched without losing its interpretational validity.

Early in the analysis it was observed that the Toronto area acted as a midpoint for the distribution of Archaic traits in Southern Ontario. In order to facilitate description, the line created by the Nottawasaga and Humber river drainages connecting Lake Ontario and Georgian Bay is regarded as the dividing line between an eastern and a western sector of Southern Ontario. All future references to eastern and western distributions apply to this postulated line.

GOUGES

Two hundred and fourteen gouges from the Museum collection and twenty-two additional specimens from publications and personal survey were segregated into six classes. The total length of the artifact was not considered, but rather the depth and relative length of the gouge depression and certain form characteristics were regarded as the salient features. The descriptive terminology is admittedly awkward. However, all dimensional references are concerned solely with the hollowed-out portion of the gouge. Figures 1 and 2 illustrate the gouge classes.

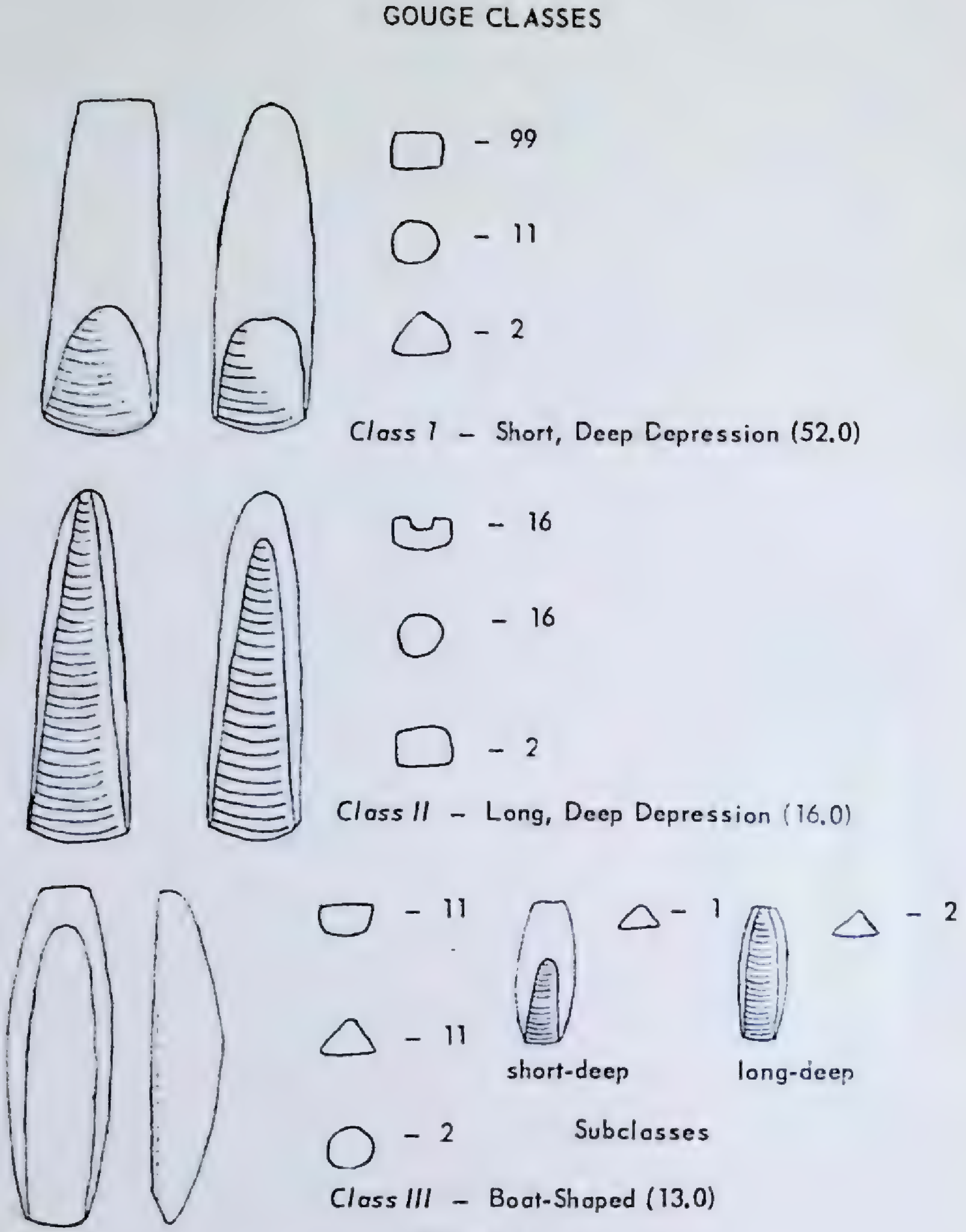

GOUGE CLASSES
- 99
- 11
- 2
Class I – Short, Deep Depression (52.0)
- 16
- 16
- 2
Class II – Long, Deep Depression (16.0)
- 11
- 1
- 2
- 11
short-deep
long-deep
- 2
Subclasses
Class III – Boat-Shaped (13.0)

FIGURE 1

CLASS 1: Short, deep gouge depression.

This class composes over half the total and may be recognized by a short, deep gouge depression which occupies at least one-third of the total artifact length. Poll cross-sections are usually rectangular.

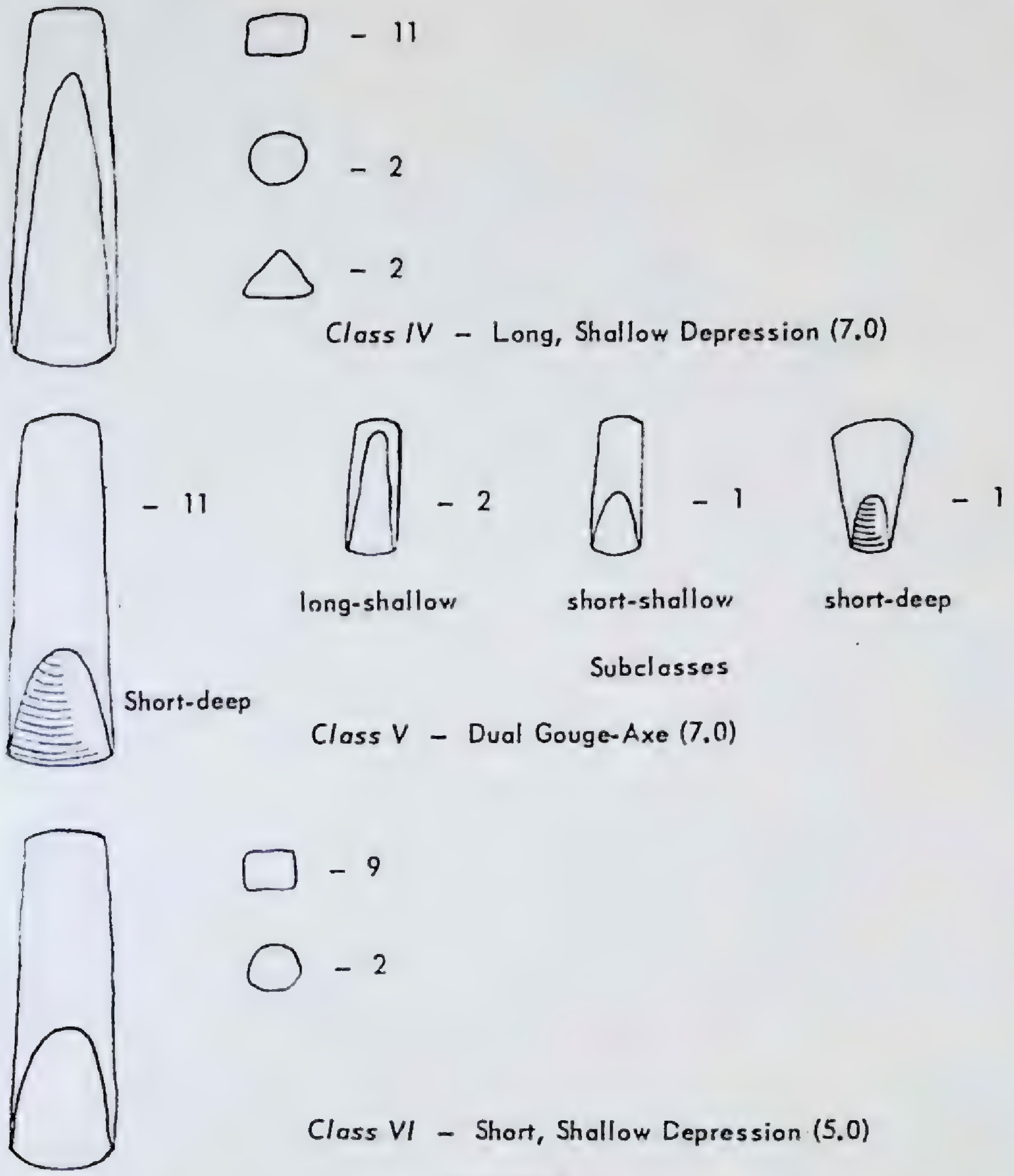
CLASS 2: Long, deep gouge depression.

This variety is usually regarded as the classic gouge, although it forms less than one-sixth of the total. Its most striking characteristic is a very deep and long gouge depression that extends to the very end of the poll or almost so. Circular and U-shaped poll cross-sections are most common.

CLASS 3: Boat-shaped.

This particular form invariably possesses a narrow bit and a narrow poll, but the mid-section is relatively broad. Seen in profile, the flat-backed gouge surface and the convex keel give a strong impression of a

GOUGE CLASSES



Class IV – Long, Shallow Depression (7.0)

Class V – Dual Gouge-Axe (7.0)

Class VI – Short, Shallow Depression (5.0)

Figure 2

boat hull. Usually the gouge depression is long and shallow, although two subclasses occur. Polls are semi-circular or triangular in cross-section.

Class 4: Long, shallow gouge depression.

The shallow gouge depression of this class extends almost to the poll. Poll cross-sections are usually rectangular.

Class 5: Dual gouge-axe.

The usual form of this class has a short, deep gouge depression and an axe bit in place of a poll. Three subclasses are determined on the basis of the gouge depression.

Class 6: Short, shallow gouge depression.

This is the rarest gouge form encountered. It is identical to Class 1, except that the gouge depression is incipient rather than pronounced. Poll cross-sections are usually rectangular.

DISTRIBUTION

The gouge is perhaps one of the most stereotyped and widespread of all the Northeastern Archaic tools. It occurs as far north as Lake Abitibi, is abundant in the Red Paint burial complex (Moorehead, 1922) of the east coast, appears as far south as the lower New England States (Willoughby, 1935), and extends westward into Wisconsin. The frequency of gouges tends to be greater in the eastern sector of Southern Ontario, with the Toronto area acting as the dividing line between east and west. This may be seen by examining Distribution Map I.

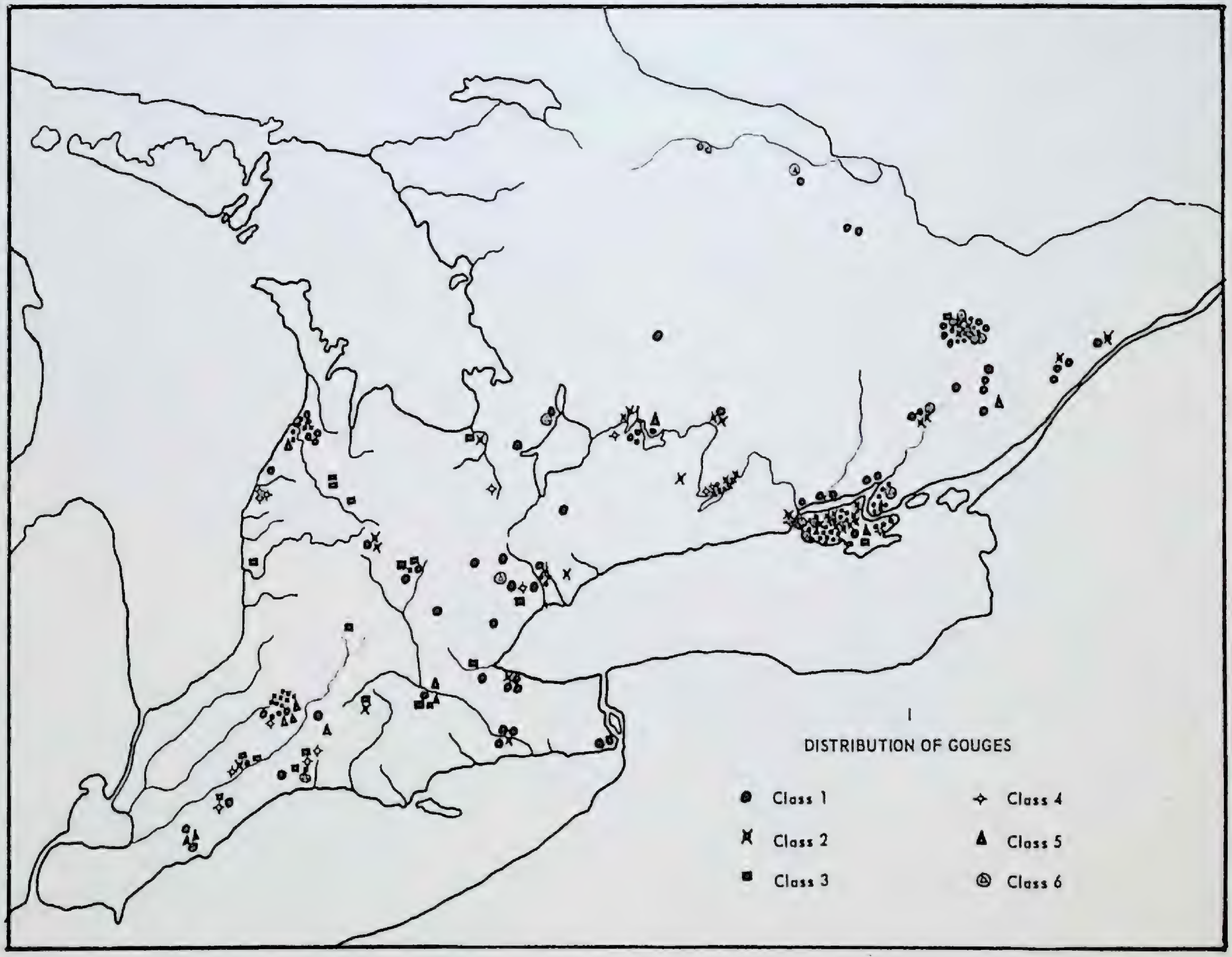
In reference to the distribution of classes of gouges, Table 1 indicates that Class 1, though generally widespread, is concentrated in the eastern sector as are Classes 2 and 6. Class 3, on the other hand, is markedly concentrated in the western sector of Southern Ontario. Classes 4 and 5 tend to be more common to the west, but their frequencies within the two sectors are too low to be of convincing spatial value.

TABLE 1. *Quantitative distribution of gouge classes in eastern and western Southern Ontario*

Class	East		West	
	No.	%	No.	%
1	78	56.9	38	38.4
2	32	23.4	10	10.1
3	4	2.9	30	30.3
4	6	4.4	10	10.1
5	6	4.4	9	9.1
6	11	8.0	2	2.0
Total	137	100.0	99	100.0

General areas of gouge concentration in Southern Ontario are to be found along the Trent Waterway, in Middlesex County, and around the mouth of the Saugeen River, in the Bruce Peninsula.

The recognition of relationships of the Southern Ontario gouges to excavated specimens is complicated by the difficulty of recognizing the classes from publication plates. In the Brewerton Focus (Ritchie, 1944), the Oberlander Site produced ten specimens of Class 1 and two examples of Class 2, whereas the Robinson Site produced twenty-six specimens of Class 1. Some gouges from the Robinson Site, however, may belong to Class 4. Ritchie (1944) also mentioned that the Vosburg Focus of Eastern New York produced gouges which appear to have the Class 1 form. An examination of the New York gouges suggests that gouge total length might be pertinent to a distributional analysis. The New York specimens of Class 1 averaged 3½ inches by 2 inches in length and width, and though gouges of this size are common in Southern Ontario there are a large number of the Class 1 gouge that attain a length ranging from 7 inches to 10 inches and tend to be narrower in proportion. Such a concentration of the longer Class 1 gouges appears at the Southampton sites located near the mouth of the Saugeen River. Here the gouges range from



Distribution Map I

6 inches to 7½ inches in length and are approximately 2 inches in breadth. Within the Red Paint Culture, or Maine Cemetery Complex as it was renamed by Smith (1948), the gouge constitutes the most common single trait. From the gouge typology proposed by Smith, it could be seen that his Basic Types 1, 2, 4, 6, 7, 8, 10, 11, and 12 correspond approximately with the Class 1 gouge of this study. It was also noted that this sequence of types accounted for 71.0 of the 338 Basic gouge forms considered. The Maine specimens of Types 3, 5, 13, and 14 lacked parallels to the Southern Ontario gouges with the possible exception of Type 14, which approached the Ontario Class 2 form. As Type 9, another of Smith's Basic Types, apparently was not illustrated, comparisons could not be made. Generally speaking, however, the Maine Cemetery Complex gouges appear to be longer, narrower, and more expertly finished than the gouges from Southern Ontario. Also, various gouges from New England possess decorative or lashing knobs or both. This attribute is foreign to Southern Ontario gouges with the single exception of a knobbed adze form reported by Wintemberg (1929). From Massachusetts and New Hampshire, Willoughby (1935) illustrates Classes 1, 2, and possibly 3. These forms, however, appear to be far outnumbered by short, stubby gouges with shallow gouge depressions running from bit to poll and possessing lashing grooves. Many of the specimens are similar in some respects to Class 1 but differ from it in that they possess various knobs, curved projections, and poll elaboration in the form of effigies or phallic symbols.

BANNERSTONES

The method of classification of the 232 bannerstones examined follows Knoblock (1939). Of the twenty-four groups of bannerstones established by Knoblock, thirteen were represented in Southern Ontario. In each grouping, numerous varieties, which are related by one or more common features, occur. Since the range of variation is great within each group, the reader is referred to Knoblock's book for illustrations and further detail. Table 2 gives the occurrence in Southern Ontario of these artifacts which are not known to have functioned as atlatl weights.

DISTRIBUTION

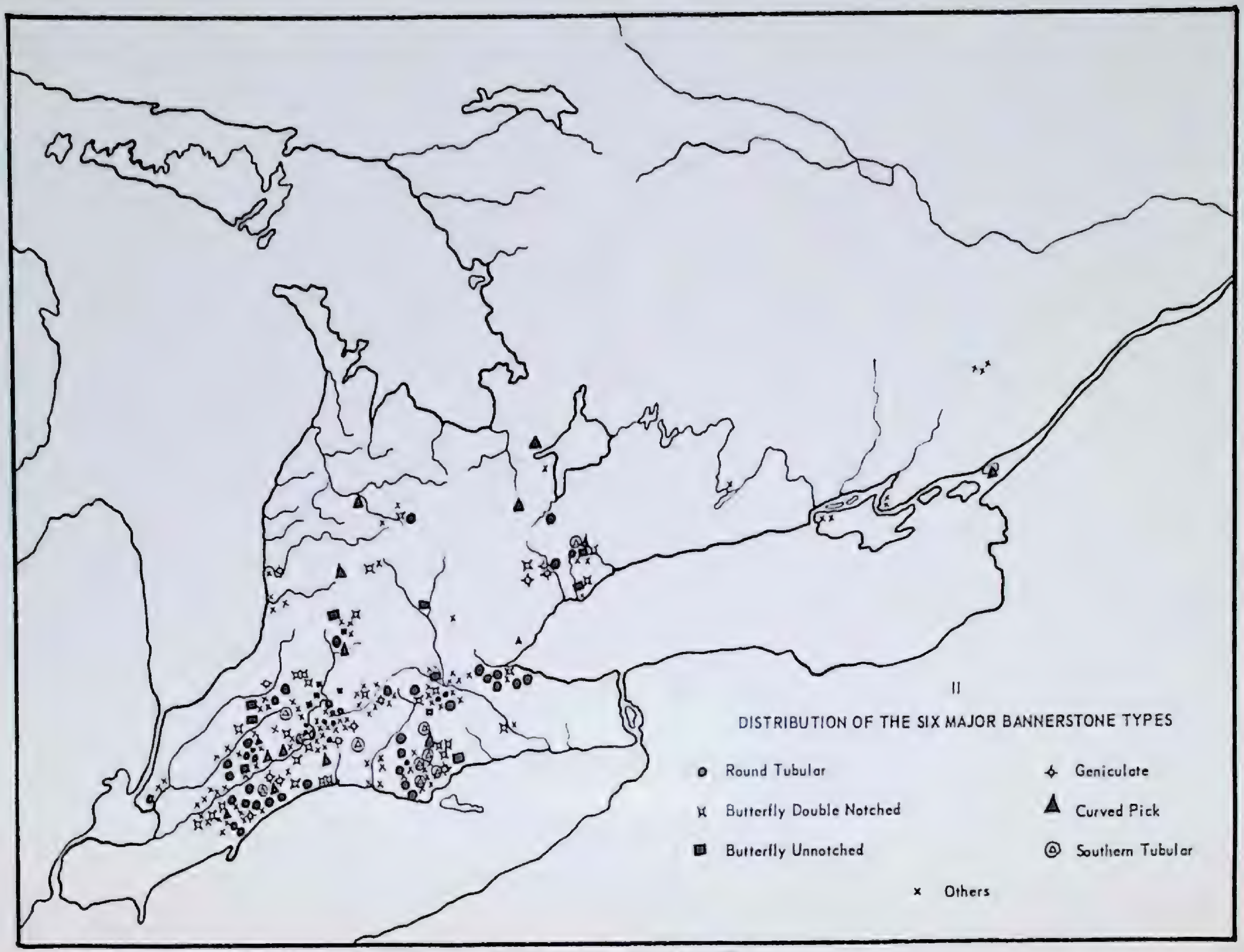
Only six of the more common bannerstone types were plotted separately on the distribution map with the remaining forms being represented by a single symbol. As can be seen from Distribution Map II, the majority of the bannerstones were found in Southwestern Ontario with major concentrations in the counties of Middlesex, Kent, Elgin, Norfolk, Oxford, and Brant. This same distribution was observed previously by Wintemberg (1929) in his examination of 260 bannerstones in the National Museum of Canada. The same writer also found the "winged form" or butterfly types to be the most common, as was found in this analysis, although the tubular group formed only a slightly smaller percentage. Of the bannerstones examined by the writer, 89.7 per cent were recovered to the west of the dividing line. Of the ten specimens east of the line, four were of the slightly curved pick type, four of the crescent group, and two of the fluted ball type.

TABLE 2. *Bannerstones of Southern Ontario*

Group	Type	No.
Butterfly	Notched	8
	Unnotched	25
	Single Notched	2
	Double Notched	43
Tubular	Fluted Ball	10
	Round Tubular	41
	Square Tubular	6
	D-shaped Tubular	4
	Southern Tubular	9
Curved Pick	Uncurved	3
	Slightly Curved	5
	Curved	16
Crescent		10
	Notched	5
Reel	Notched	12
Geniculate		11
Double Bitted Axe		8
Knobbed Lunate		4
Notched Ovate		4
Rectangular Banded		2
Shield-shaped		2
Triangular		1
Southern Double-edged		1
Total		232

Bannerstones excavated in New York State include seven of the crescent group from the Frontenac Site, five of the butterfly group and two of the crescent group from the Robinson Site, and one of the butterfly group from the Oberlander Site (Ritchie, 1944). In the case of the crescent types, identification was fairly accurate, but placement of the butterfly group into the Knoblock typology depended on verbal description so that a margin of error should be considered. The descriptive terms used by Ritchie with reference to the butterfly types were oval, trapezoid, and intermediate.

East of the Mississippi River the bannerstone is found throughout the United States and appears to be of southern origin (Knoblock, 1939). Within such northern manifestations of the Eastern Archaic as the Laurentian Aspect, the bannerstone apparently was of relatively little importance from a quantitative point of view. As can be seen from Distribution Map II, it would appear that the Archaic peoples of the western area of Southern Ontario were being subjected to influence derived from the south. As one moves north and east in Southern Ontario, the quantity and variety of bannerstones rapidly decrease. For example, a short distance to the south of Ontario, in Western New York State, all twenty-four groupings of bannerstones are found, and although thirteen groups do occur in Southern Ontario, only three of these are found east of the Toronto dividing line.

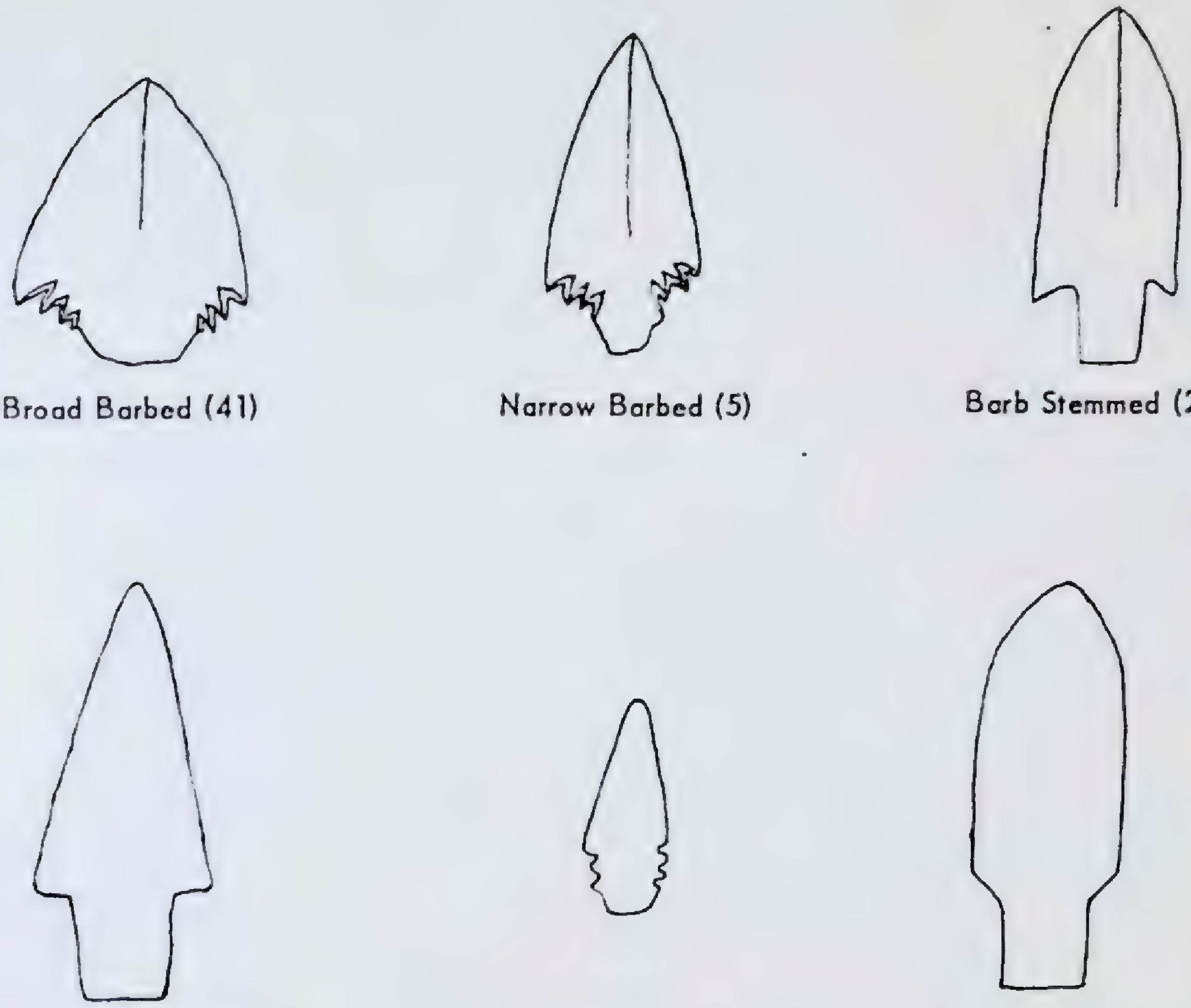


Distribution Map II

GROUND SLATE PROJECTILE POINTS

Analysis of the ninety-six specimens of ground slate projectile points in the collection resulted in the formulation of the six classes illustrated in Figure 3. All possess either a flat-diamond cross-section or a biconvex cross-section with the former predominating.

GROUND SLATE PROJECTILE POINT CLASSES



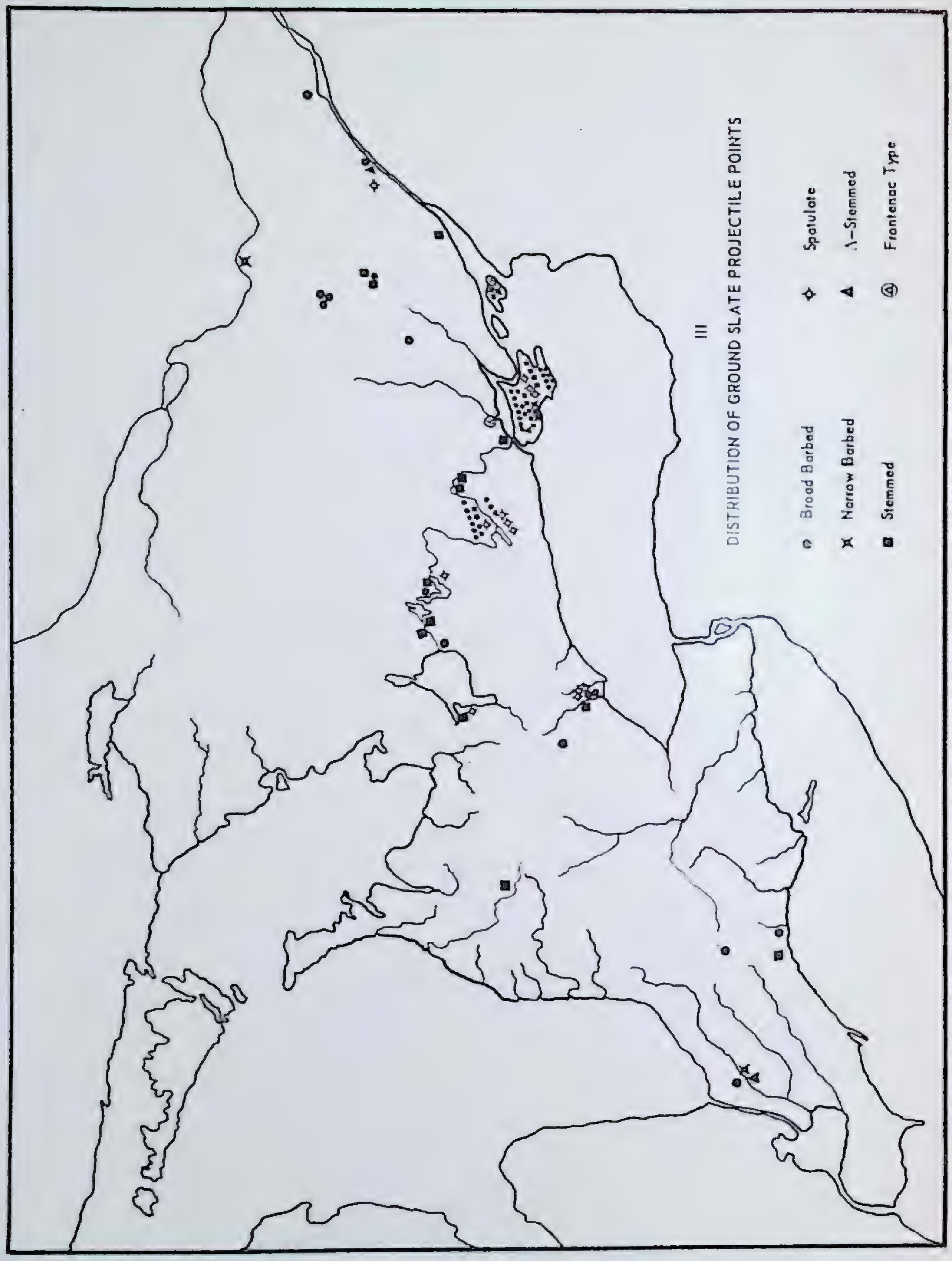
Broad Barbed (41) Narrow Barbed (5) Barb Stemmed (26)

Triangular Stemmed (3) Frontenac (1) Spatulate (20)

FIGURE 3

DISTRIBUTION

As Distribution Map III reveals, the main area of concentration is in Eastern Ontario with only nine points occurring west of the Toronto dividing line. Within the eastern part of the province, the Trent Waterway and neighbouring districts produced sixty-four specimens. Ground slate projectile points were recovered from the Parker Site on the Trent River (Leechman and De Laguna, 1949). In no single complex at present known in the Northeast, however, are ground slate projectile points common. In fact, they are, as a general rule, quite rare. Even in the Maine Cemetery Complex, as reported by Smith (1948), these artifacts represent only 4.4 per cent of the implements recovered from twenty-six burial sites which produced a total of 1,861 artifacts. From New York State, information on ground slate projectile points is extremely sparse. A single spatulate form has been found within the Brewerton Focus. The Frontenac Site produced



DISTRIBUTION MAP III

one spatulate form and a small serrated form identical to a specimen recovered in the Bay of Quinte area. A single fragmentary point was found on a Lake Champlain Valley site along with a ground slate bayonet fragment and nine ground slate semilunar blades (Bailey, 1939)[1]. The northernmost distribution of the slate projectile point forms under consideration appears to be the Temagami district in Northern Ontario, and although specimens of ground slate points have been found farther north (Ridley, 1956), they are typologically distinct from the Southern Ontario and New York specimens. Frederica De Laguna (1946; 133), in her examination of ground slate projectile points, made the following statement, which is in complete agreement with the findings of this analysis:

> "In any case, the more southern Indians developed two main types of slate blade. The first is simply the leaf-shaped blade with shoulders undercut to produce barbs, the other adds notches to the tang. Both types, but especially the second, include rather broad, short, forms with abruptly contracting tangs on which the notches appear like additional small barbs."

De Laguna noted that both forms are common in Ontario and New York and that they are also found in Vermont. The stemmed class occurs in the same area as well as being found in Connecticut, the Nevin Shell heap, and the Maine Cemetery Complex. Ground slate points described and illustrated by Willoughby (1935) from Vermont duplicate the forms of the Ontario–New York area perfectly. On the basis of distributional and classificatory evidence, the Southern Ontario–New York–Vermont area may tentatively be regarded as a homogeneous ground slate projectile point locale. Outside that area one encounters predominantly different forms.

Generally speaking, the ground slate projectile point is a northern and eastern trait, being most common in the eastern sector of Southern Ontario, the St. Lawrence Valley, and coastal Maine.

BAYONETS

The most common ground slate bayonet form, which represents nine of the eleven specimens examined, has been called the Ontario Bayonet. It possesses an abruptly rounded tip and a bevelled wedge-shaped base, and is generally straight-sided. The cross-section is usually a broad pie-wedge shape but may also be an asymmetric diamond shape. All the specimens of this class possess a sharp, wedge butt produced by a ground bevel on one face. In all cases of tanged or notched bayonets of the Ontario class, this original basal bevelling is clearly observable. The basal bevel tapers forward in the form of a sharp V to the longitudinal ridge which runs nearly the entire length of the artifact. Figure 4 illustrates the variation within the Ontario Bayonet class, along with two other classes found in the collections.

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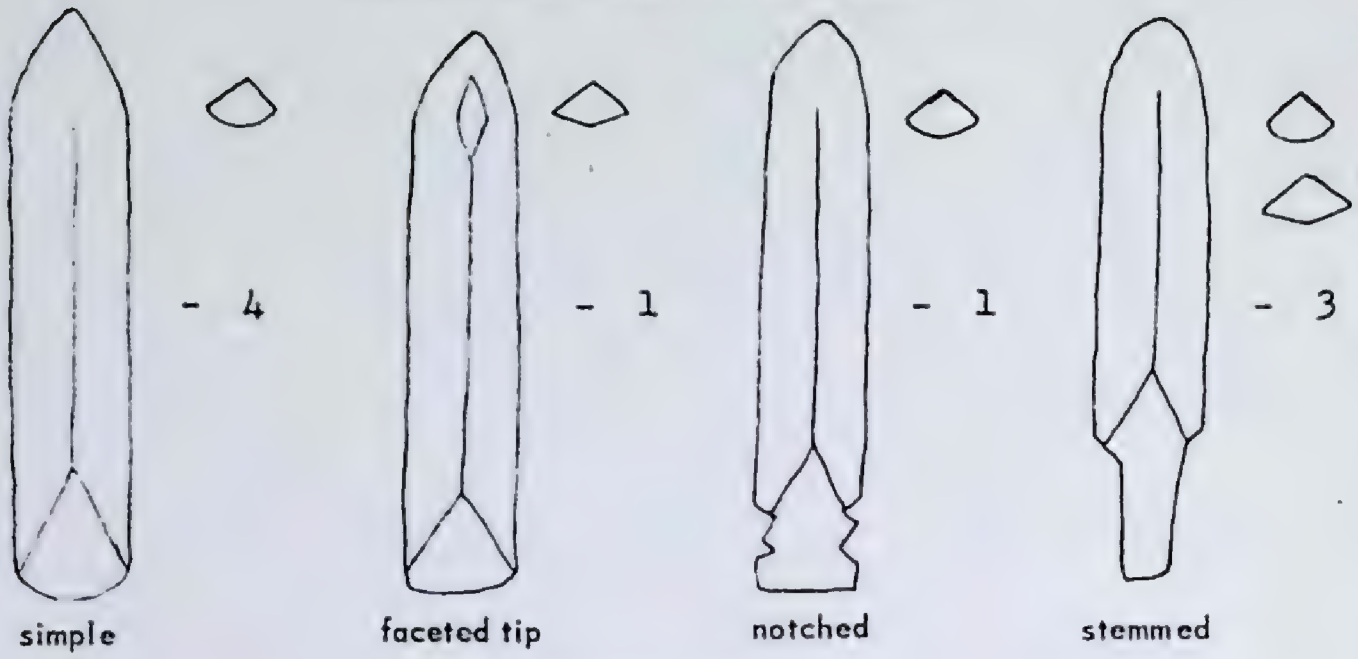
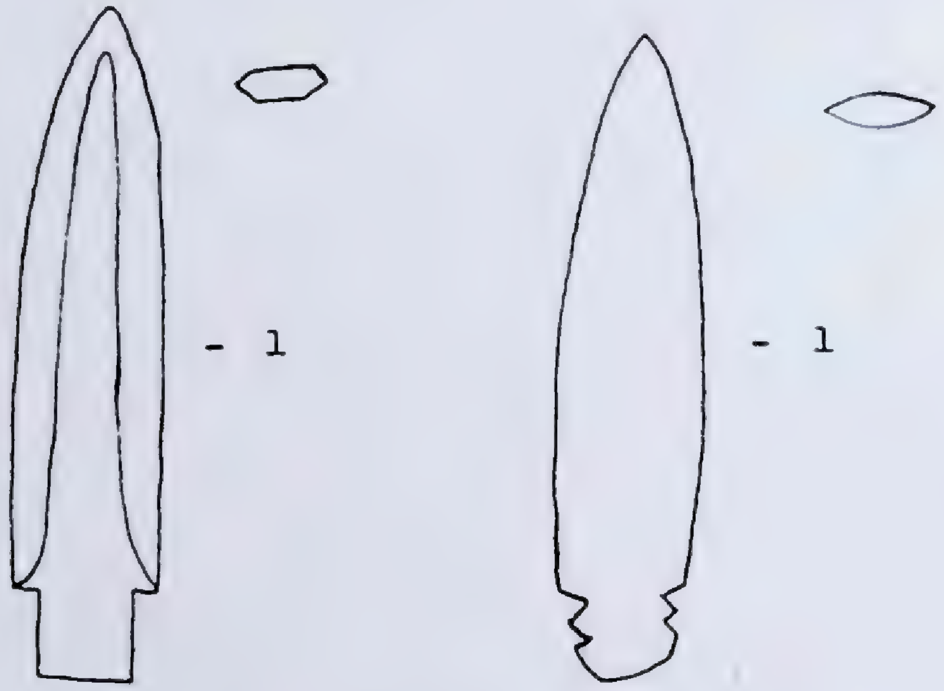
[1] In a paper presented at the 1960 American Anthropological Association meetings in Minneapolis, Minnesota, Ritchie described an Archaic site in Southwestern Vermont which produced ground slate points, predominantly of the Barbed Stemmed form. The complex found at this site would appear to rejuvenate the earlier suggestion of a Vergennes Focus of the Laurentian Aspect (Ritchie, 1944).

GROUND SLATE BAYONET CLASSES



Ontario Bayonet



Hexagonal Stemmed Lenticular Notched

Figure 4

DISTRIBUTION

As can be seen from Distribution Map IV the frequency of bayonets in the eastern and western sectors of Southern Ontario is nearly uniform. Placement of additional specimens was possible through Wintemberg (1929). De Laguna (1946) notes the presence of a single instance of the Ontario Bayonet in New York State and several specimens from Maine. Ritchie (1944) apparently found two examples of this class in association with Brewerton material in New York State. The remaining two bayonets from Ontario consist of a broad, stemmed point with a hexagonal cross-section of a form common to Nova Scotia, Quebec, New York, and Maine (De Laguna, 1946) and a long, barbed tang point with a biconvex cross-section.

PLUMMETS

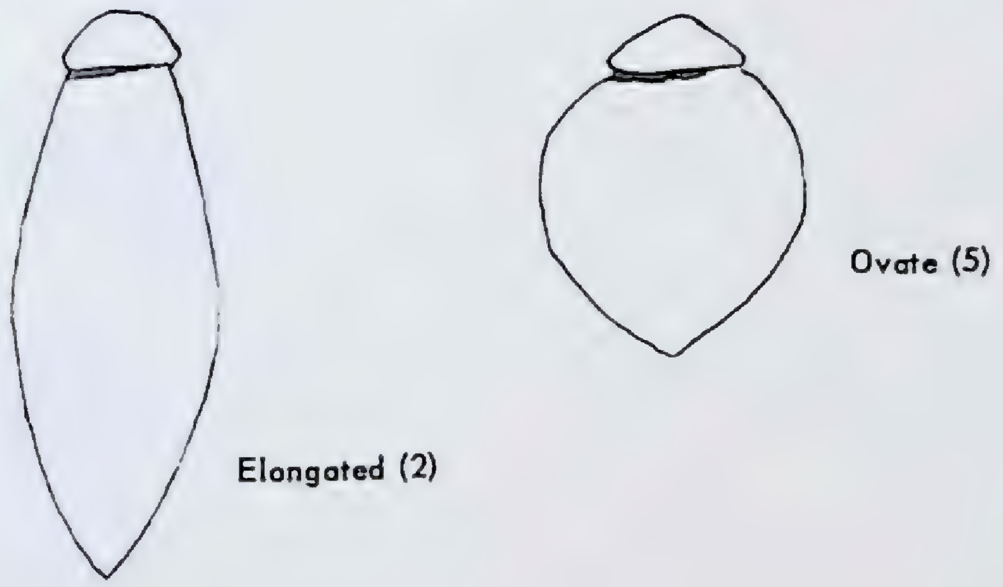
Only seven plummets from Southern Ontario were encountered in the collection. These fell into two classes, called Elongate and Ovate, and are illustrated in Figure 5. All the plummets were suspended by a single encircling groove at one end.

DISTRIBUTION

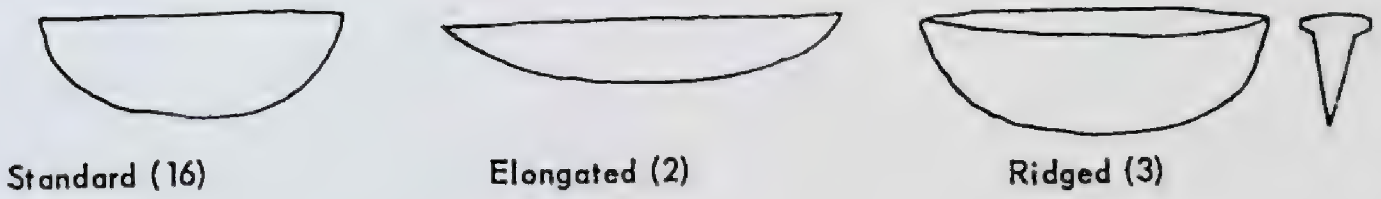
Distribution Map IV shows that the plummet was generally dispersed in Southern Ontario, although the sample is too low to be spatially indicative. In New York State, the Frontenac Site produced nine plummets, of which eight are of the Elongate form and one is of the Ovate class. Two ovate plummets were recovered from the Oberlander Site (Ritchie, 1944). The plummet appears to be a rather unimportant cultural trait of the Ontario and inland New York Archaic peoples. Along the east coast of the New England States, however, it reached its zenith in popularity and development.

SEMILUNAR BLADES

The twenty-one polished slate semilunar blades in the collection were subdivided into the three varieties illustrated in Figure 5. Five flaked semilunar blades were also observed in the collection.

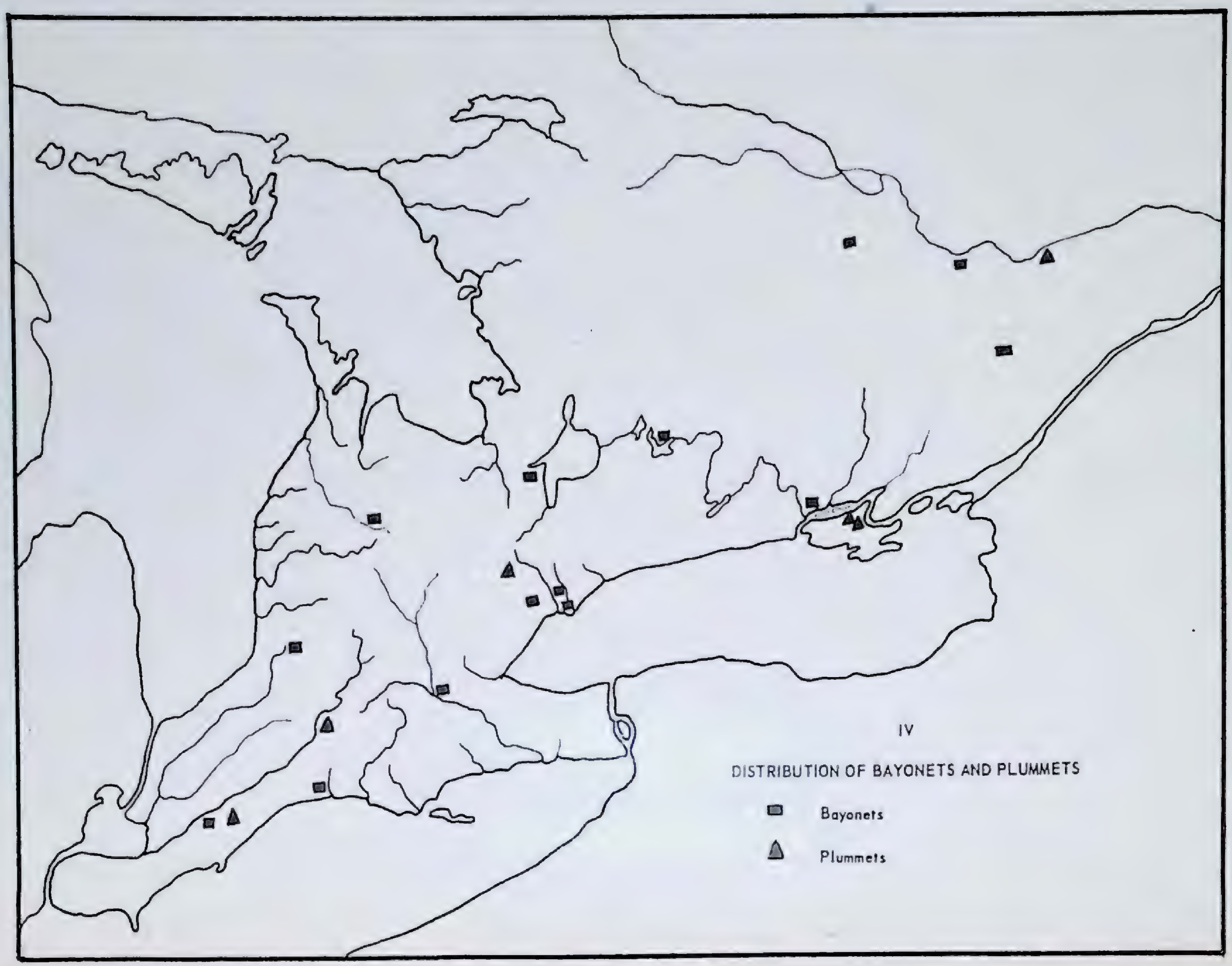


PLUMMETS



SEMILUNAR BLADES

Figure 5



Distribution Map IV

DISTRIBUTION

Distribution Map V indicates that the semilunar blade extends from east to west in Southern Ontario with a slight concentration in the Rice Lake area. In New York State a single incised fragment of a semilunar blade was recovered from the Frontenac Site, and a single, flaked sandstone specimen was found on the Oberlander Site (Ritchie, 1944). In Vermont, semilunar blades apparently increase in importance. Nine fragments of semilunars, one belonging to the Ridged type, were recovered from the Donovan Site in the Champlain River Valley (Bailey, 1939). The distribution of semilunars in the Northeast has been summarized by De Laguna (1946; 125) as follows: New York—over 33; Southern Ontario—over 30; Massachusetts—over 26; New Jersey—over 16; Connecticut—14; Maine—10; Vermont—9; Pennsylvania—8; New Hampshire—7; Rhode Island—4; New Brunswick—3; Delaware—3; Nova Scotia—1; and Ohio—1. De Laguna also notes that the standard form is common in Ontario, Maine, and Vermont, while the ridged form is predominant in New Hampshire, Massachusetts, Connecticut, and eastern New York. Semilunar blades from Massachusetts, Connecticut, Rhode Island, and New York frequently have lashing holes at the base (one in the middle, at one end, or at both ends), and these holes are usually gouged out rather than drilled or bored.

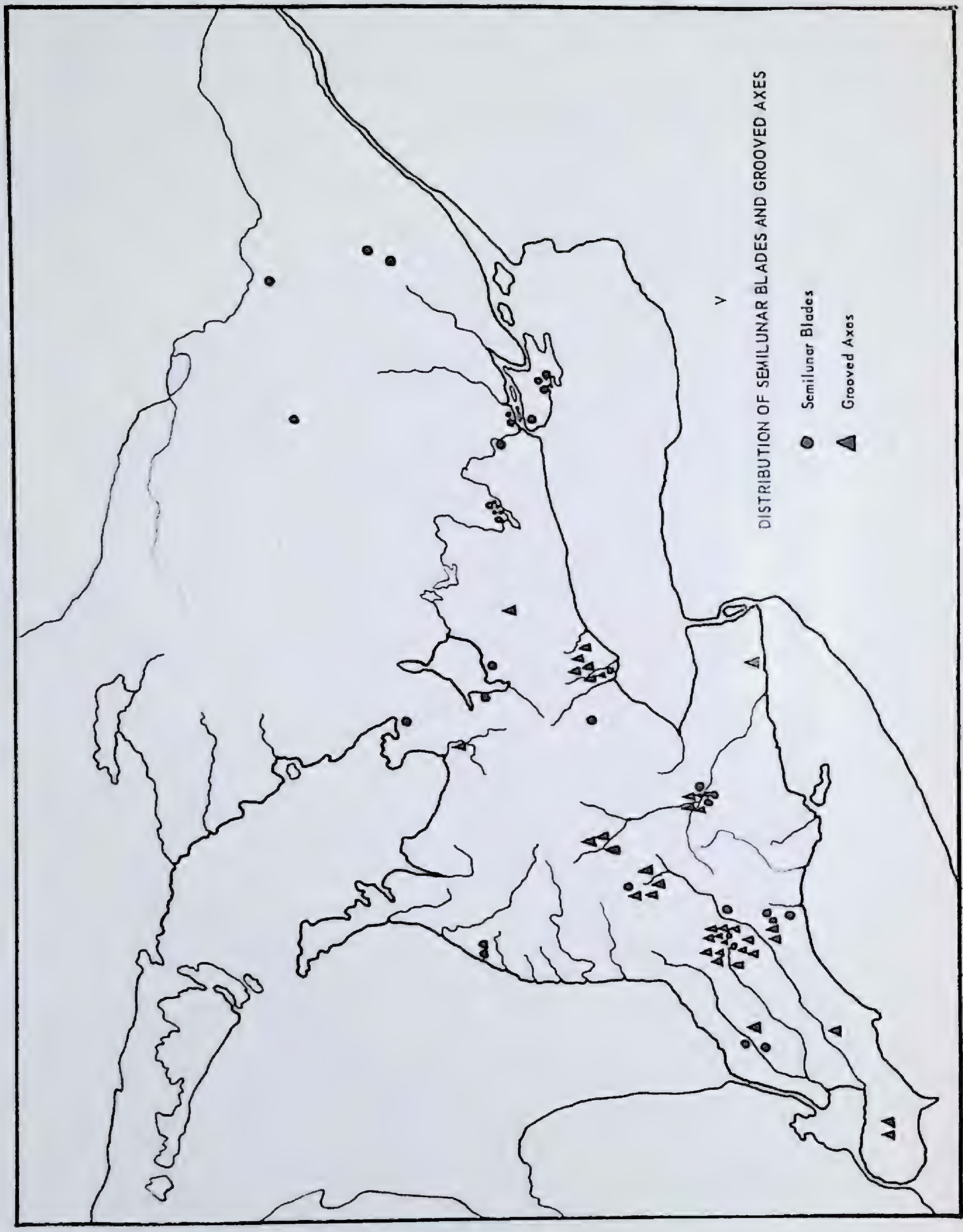
GROOVED AXES

Of the thirty-eight grooved axes examined, all had a full lashing groove running at right angles to the long axis of the artifact. There was a wide range in the degree of finish on these artifacts as well as the means of groove construction. but a separation of varieties was avoided on the grounds of small sample size.

Workmanship is usually crude with large flake scars frequently visible. In fact, a number of specimens lack any grinding, with the sole exception of the lashing groove. Wintemberg (1929) recognized two varieties of grooved axes in his examination of 144 specimens from Ontario and Quebec, the full grooved axe and the partially grooved axe. He also noted a few examples of multi-grooved axes and a single obliquely grooved specimen.

DISTRIBUTION

As indicated by Distribution Map V, the majority of the grooved axes came from the western sector of Southern Ontario with only seven specimens occurring east of the Toronto dividing line. Wintemberg (1929) reported that of the grooved axes he had recorded, by far the greater number occurred in Western Ontario and that their frequency steadily decreases as one advances eastward. The grooved axes reported from the "Early" Focus of the Coastal Aspect by Ritchie (1944) are markedly different from the Southern Ontario specimens in their form and in their finished appearance. There are correspondences to the south and west, but their implications are still tentative. For example, the Archaic Panhandle Complex of Ohio (Mayer-Oakes, 1955) possesses grooved axes identical to the Southern Ontario specimens. The area of grooved axe concentration corresponds to the area of bannerstone concentration in Southern Ontario.



Distribution Map V

This correspondence suggests the possibility of the two traits coming into the Ontario peninsula as part of a complex, almost certainly derived from south of the Great Lakes.

SUMMARY

The consideration of seven Archaic traits in Southern Ontario from a distributional and classificatory point of view has allowed certain general conclusions to be made regarding the pre-ceramic occupation of the area. Because of the nature of the collection studied, conclusions have been largely restricted to spatial observations.

In the examination of Archaic traits in Southern Ontario, it was found feasible to separate the area into an eastern and western sector by establishing a dividing line at Toronto. As has been stated earlier, this line falls along the Humber and Nottawasaga river drainages, which connect Lake Ontario to Georgian Bay. Using this division the following observations were made:

1. Gouges were slightly more prevalent in the east with Classes 1 and 2 being largely eastern forms and Classes 3 and 6 occurring mainly in the west.
2. Bannerstones were predominantly a western trait with 90.0 per cent of the total sample occurring in this sector. Only the crescent group, the curved pick type, and the fluted ball type were found east of the dividing line, though thirteen groups and thirteen types occurred in the western sector (after Knoblock's classification).
3. Over 80.0 per cent of the ground slate projectile points were found east of the dividing line, and the spatulate class was restricted to the east.
4. Bayonets, plummets, and semilunar blades tended to be generally distributed throughout both sectors.
5. Grooved axes were concentrated in the western sector where 82.0 per cent of the total were found.

Taking into consideration the extensive area occupied and the time span involved, it is not surprising that a large number of variant expressions of a generalized Boreal Archaic should be found. The diffusion of traits, whether direct or indirect, and the presumed movement of peoples have been multiple and complex. A southern source appears to have produced the bannerstone and the full-grooved axe, but the ground slate projectile point apparently was derived from a northern and eastern locale.

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THE DEVELOPMENT OF THE TYMPANIC PLATE

By J. E. Anderson[1]

The tympanic plate is a curved, rectangular part of the temporal bone forming the anterior wall and floor of the external auditory meatus which leads internally to the tympanic membrane or ear drum. This paper describes the formation of the tympanic plate and the incidence of a defect which may occur in its medial third.

The significance of the findings to physical anthropology are twofold:

1. Archaeological skeletal material provides data on the development of bone not available from the normal sources in departments of anatomy.
2. A defect in the tympanic plate is one of the non-metrical morphological characters of the skull showing a varying incidence in different populations.

The Literature

The tympanic plate develops after birth from the *tympanic ring,* a C-shaped bony structure which forms a frame for the tympanic membrane. The description of its formation has become quite standardized over the years, as may be seen by consulting anatomical textbooks such as Quain (1896), Morris (1907), Keith (1948), and Frazer (1958). A typical account is given in Gray (1958):

> "The tympanic ring grows laterally and backwards to form the tympanic part of the bone. This growth does not, however, take place at an equal rate all around the ring, but occurs most rapidly on its anterior and posterior portions, and these outgrowths meet and blend."

In a more recent account, Weinman and Sicher (1955) show photographs of the developing tympanic plate and comment as follows:

> "This bone, at first a C-shaped ring, changes into an almost closed bony tube. In the course of this change of the tympanic ring to the tympanic bone, a defect persists for a few years in the floor of the bony acoustic meatus. Remnants of this defect, which normally closes in the third year of life, persist in almost 20 per cent of adult skulls and should not be confused with a traumatic defect."

The unswerving loyalty to a standard description in the textbooks, the apparent contradiction between this description and the appearance of young temporal bones from archaeological sites, and the high percentage of defects in the tympanic plate in some North American Indian series stimulated a more careful examination of the region in available skeletal material.

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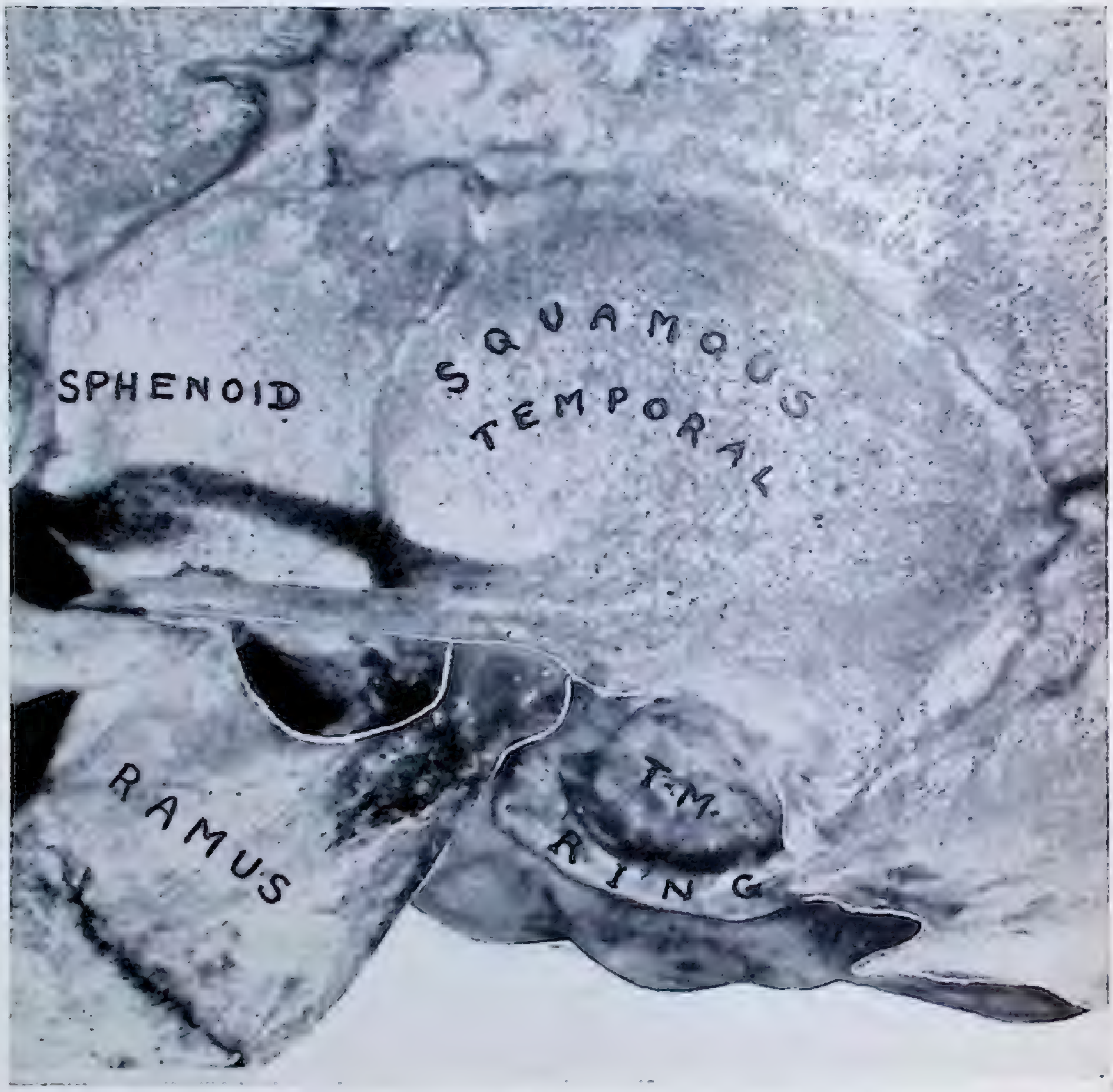
Material and Methods

The tympanic region was examined in 18 juvenile skulls from India and in 50 infant temporal bones from Ontario Iroquois sites. It was possible to arrange this material in a developmental sequence showing each stage from tympanic ring in the newborn to completed tympanic plate in the late adolescent.

One hundred and ninety-three adult temporal bones from the Fairty site were examined for the presence of defects in the tympanic plate. Each specimen was studied using a low power stereoscopic microscope to ensure that true defects were not confused with postmortem damage.

The Fairty site is a twelfth century Iroquois ossuary located in Scarborough Township near Toronto, Ontario. Excavation was done in 1956 by the Ontario Archaeological Society. The osteological report is in preparation.

Plate I



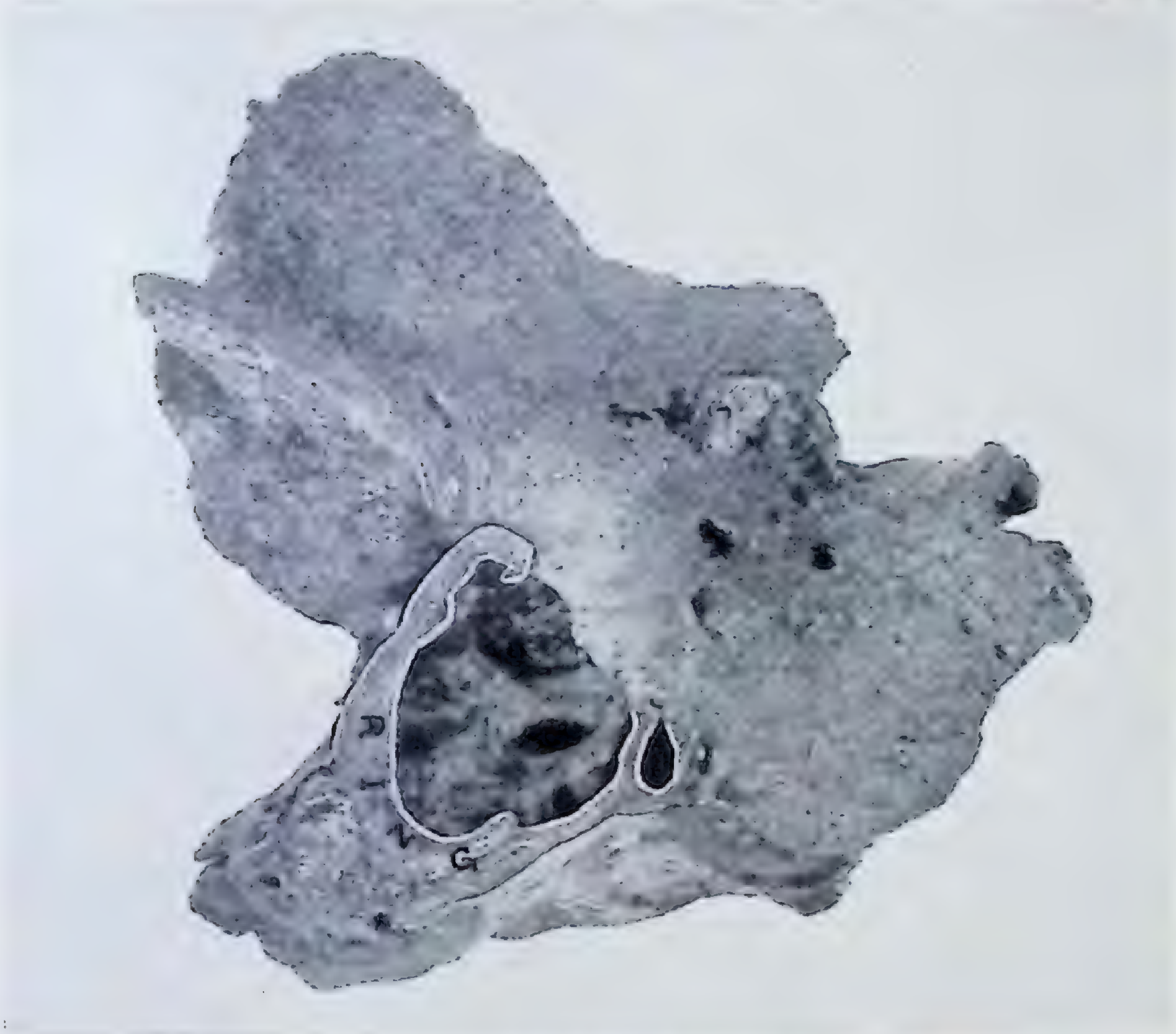
Side view of the left temporal region of a newborn skull. The tympanic membrane (T.M.) is framed by the tympanic ring.

Formation of the Tympanic Plate

Stage One. At birth, there is no bony external auditory canal. The tympanic ring is a delicate, C-shaped structure which almost entirely surrounds the tympanic membrane like a picture frame. It is a discrete entity, not yet fused to the rest of the temporal bone. As is shown in Plate I, the tympanic ring lies more in a *horizontal* than in a vertical plane, the open end of the "C" being directed mainly *laterally*, but also slightly upward and backward. It may be described as having a central curved part, an anterior and a posterior limb.

Stage Two. Early in the postnatal period, the tympanic ring fuses with the petrous and squamous parts of the temporal bone. Plate II illustrates a very young temporal bone in which the ring has fused medially and posteriorly; the lateral extremities are fused, but the anterior limb has not yet fused.

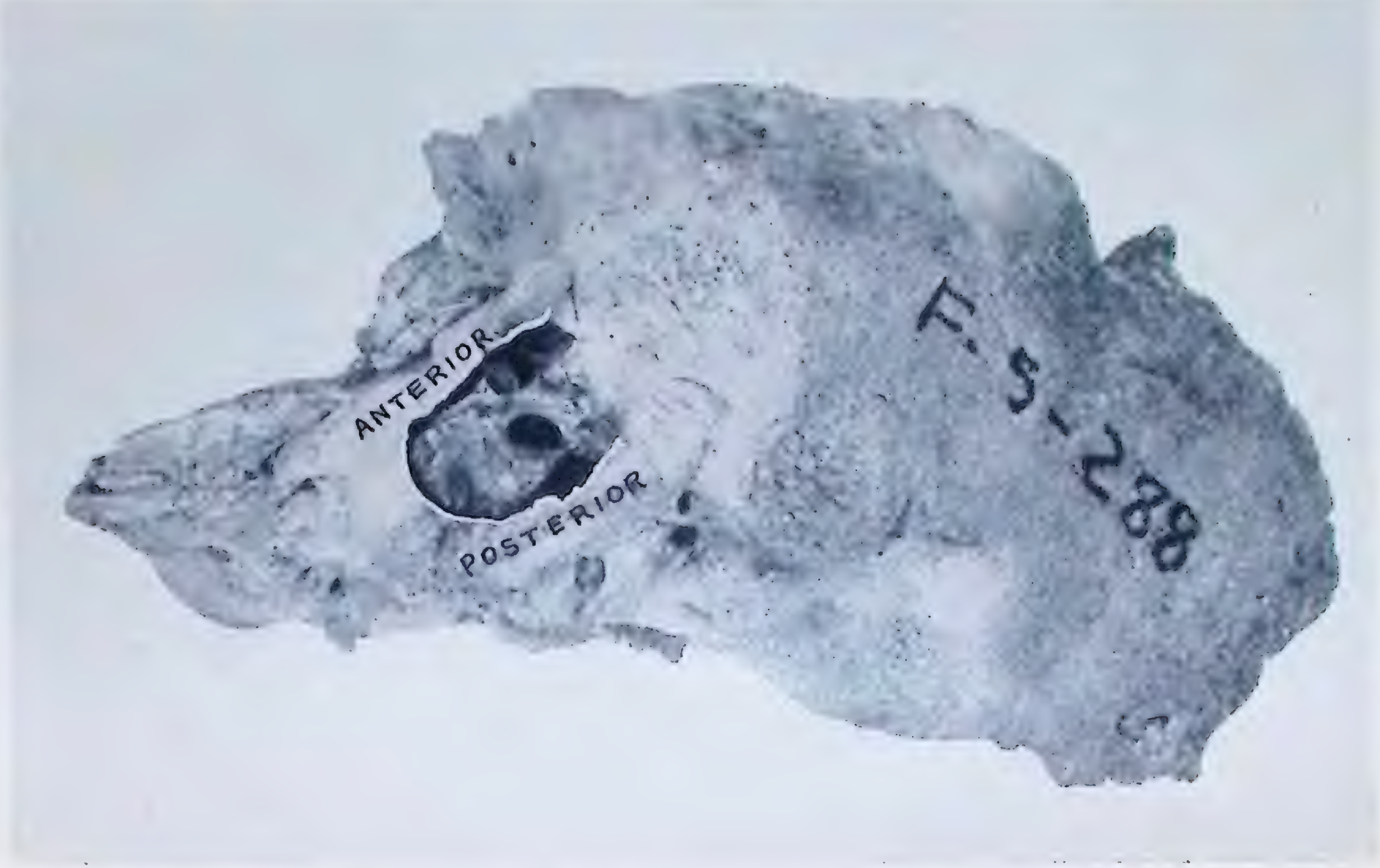
Plate II



An infant left tympanic ring fused to the temporal bone.

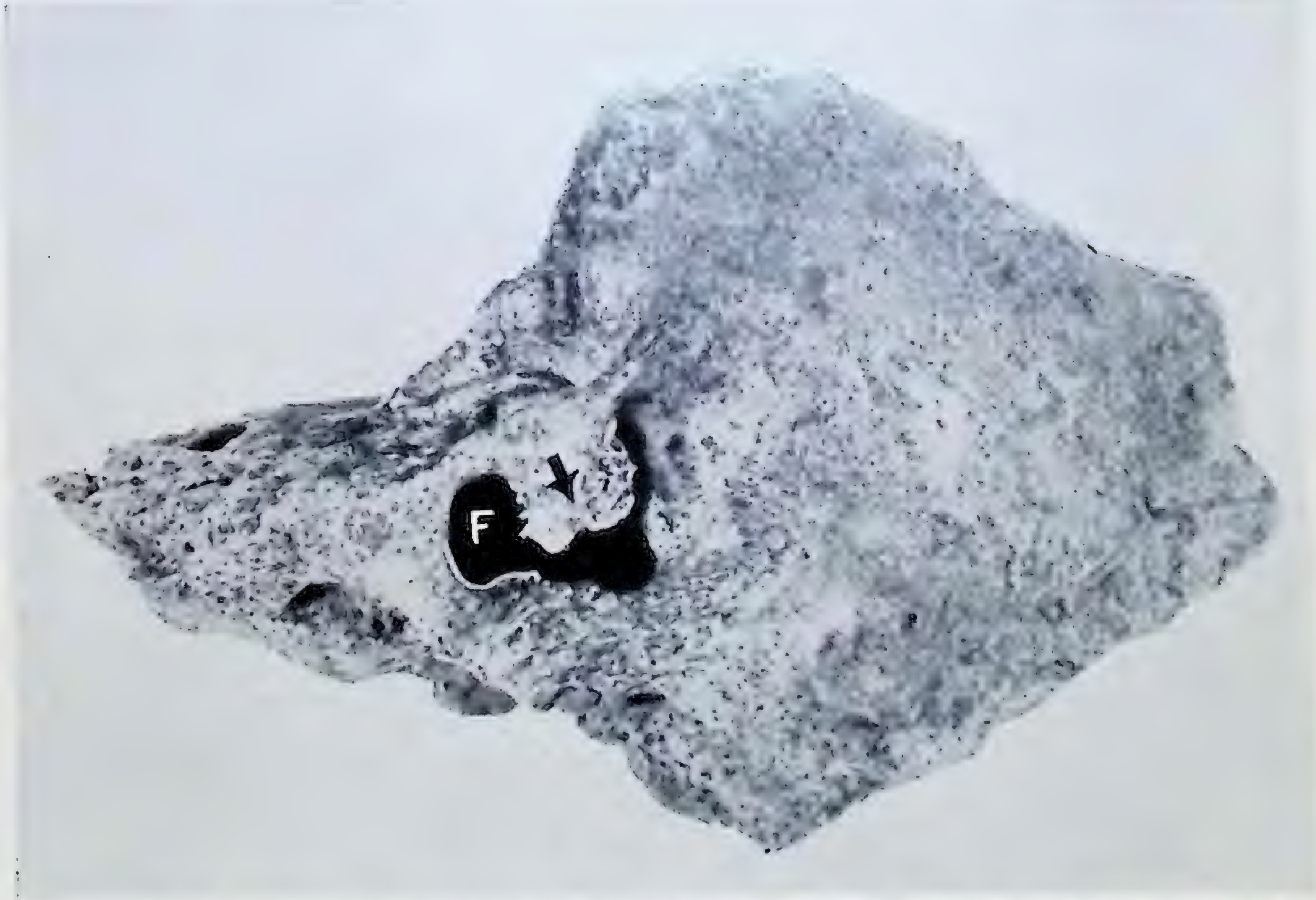
Stage Three. The beginning of this stage is illustrated in Plate III. The central part of the tympanic ring is thick, rounded, and fused medially. However, the opposed surfaces of the anterior and posterior limbs begin to show irregularities of their margins. It is from these two limbs that growth of the bone is to occur.

Plate III



Infero-lateral view of an infant left temporal bone showing the anterior and posterior limbs of the tympanic ring.

Plate IV

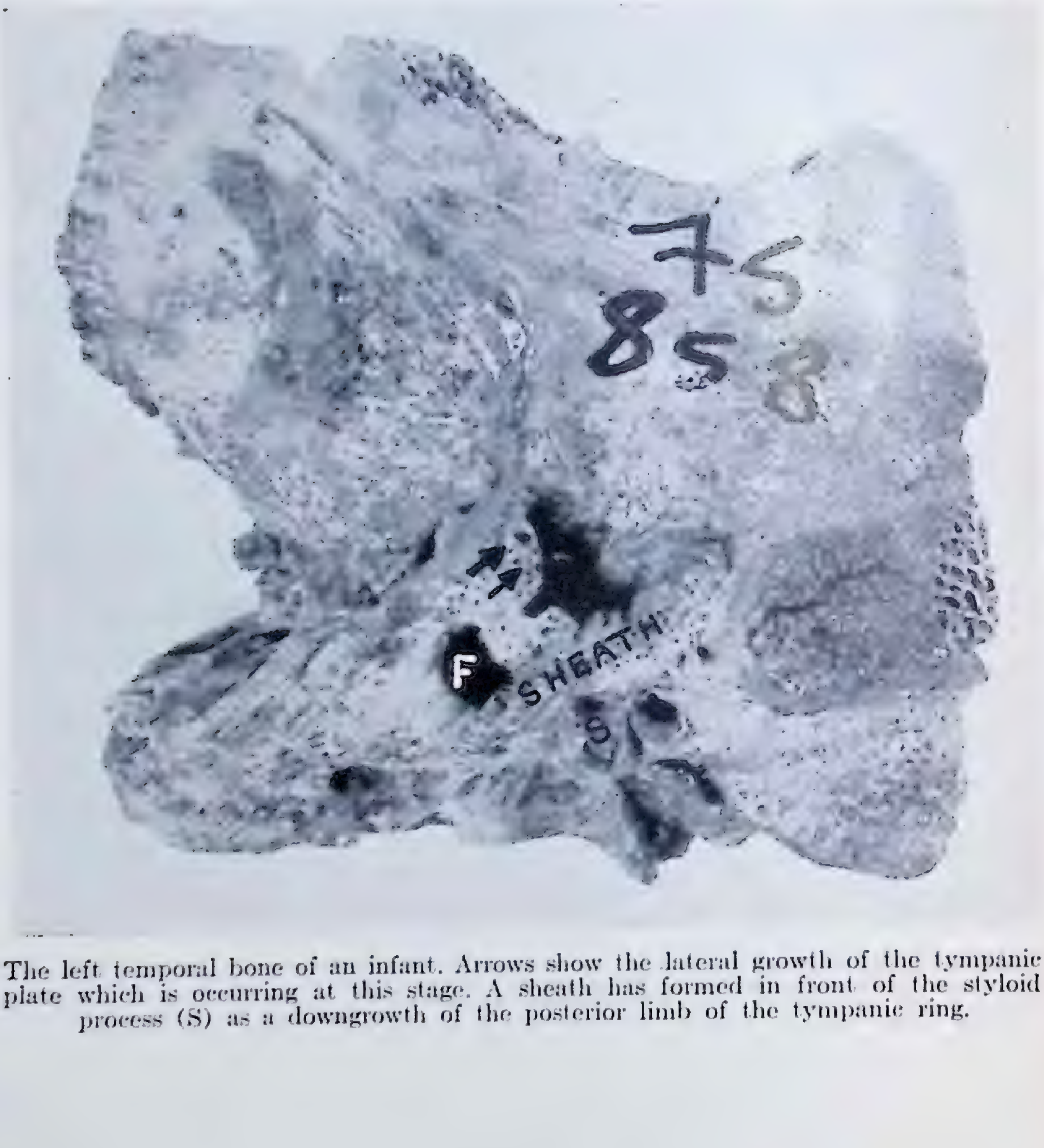


A developing left tympanic plate. An arrow shows the direction of bone growth from the anterior limb of the tympanic ring, and F denotes a developing defect in the floor of the auditory canal.

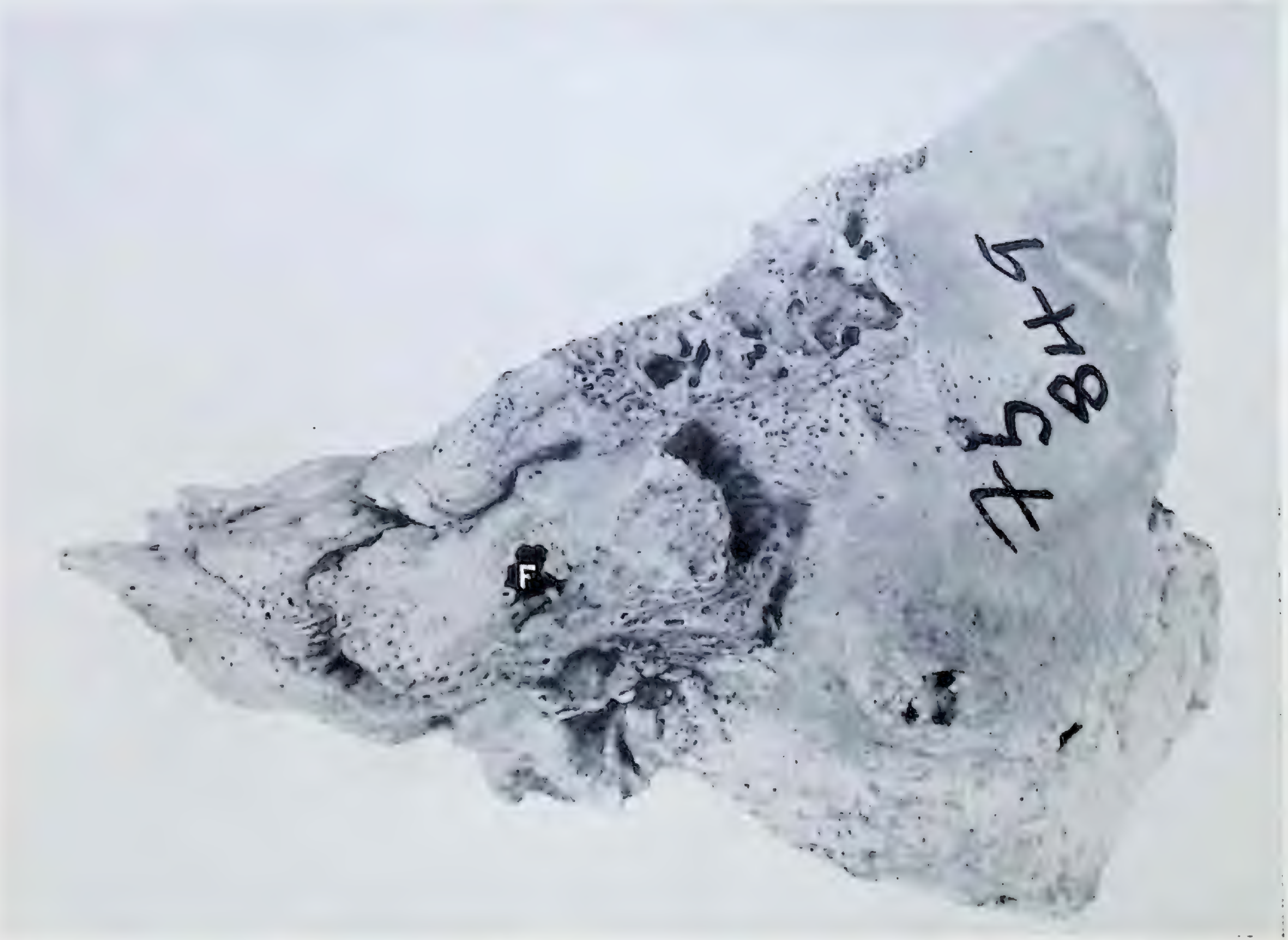
Stage Four. The tympanic region of an older temporal bone is shown in Plate IV. In this specimen, a process has grown backwards from the anterior limb of the tympanic ring. The backward direction of its growth is shown by an arrow. This posterior extension of the anterior limb of the ring partially delimits a circular gap or dehiscence whose margin is rounded anteriorly, medially, and posteriorly, but laterally is irregular. As may be seen, the posterior limb of the tympanic ring is taking no part in the development of the bony external auditory canal. It is, however, growing *downwards.*

Stage Five. During this stage, the posterior process of the anterior limb grows backwards to meet the downgrowth of the posterior limb, to which it becomes fused. Plate V illustrates a temporal bone in which this fusion has occurred, now completely enclosing a foramen in the floor of the external auditory canal. The margins of this foramen are rounded and smooth, except laterally.

Plate V



The left temporal bone of an infant. Arrows show the lateral growth of the tympanic plate which is occurring at this stage. A sheath has formed in front of the styloid process (S) as a downgrowth of the posterior limb of the tympanic ring.



A left temporal bone in which lateral growth of the tympanic plate is almost complete. The foramen (F) is closing by ingrowth from its margins.

Arrows show the direction of lateral growth of the developing tympanic plate. At this stage, the tympanic plate is longer anteriorly than it is posteriorly. Its lateral margin is porous, trabeculated, and obviously derived from the anterior limb of the tympanic ring.

While growth of the bony external auditory canal has been occurring, the *posterior* limb of the tympanic ring has grown downward, forming an anterior sheath for the styloid process.

Stage Six. Completion of the tympanic plate now requires only its full growth laterally and the obliteration of the dehiscence in the floor of the external auditory canal. Plate VI illustrates an older temporal bone in which the foramen, formed during the development of the tympanic plate, is being filled in by tiny finger-like processes of bone derived from the margins of the foramen.

Dehiscence in the Tympanic Plate

The persistence into adult life of a dehiscence in the tympanic plate in certain individuals has long been recognized. That dehiscence has been named the *Foramen of Hushke;* when present, it is found in the medial third of the tympanic plate. An example of this foramen is shown in Plate VII. Its incidence is lower in males than in females, and if unilateral, it is more common on the left side than on the right.

The incidence of this defect has been reported from a number of archaeological sites:

Wood-Jones (1931–33) studied the tympanic plate in skulls from four areas. He reported an incidence of the defect in 3 per cent of 100 Hawaiian crania, 32 per cent of 92 from Guam, 12 per cent of 100 from Northern China, and absence of the defect in 91 skulls from Tasmania.

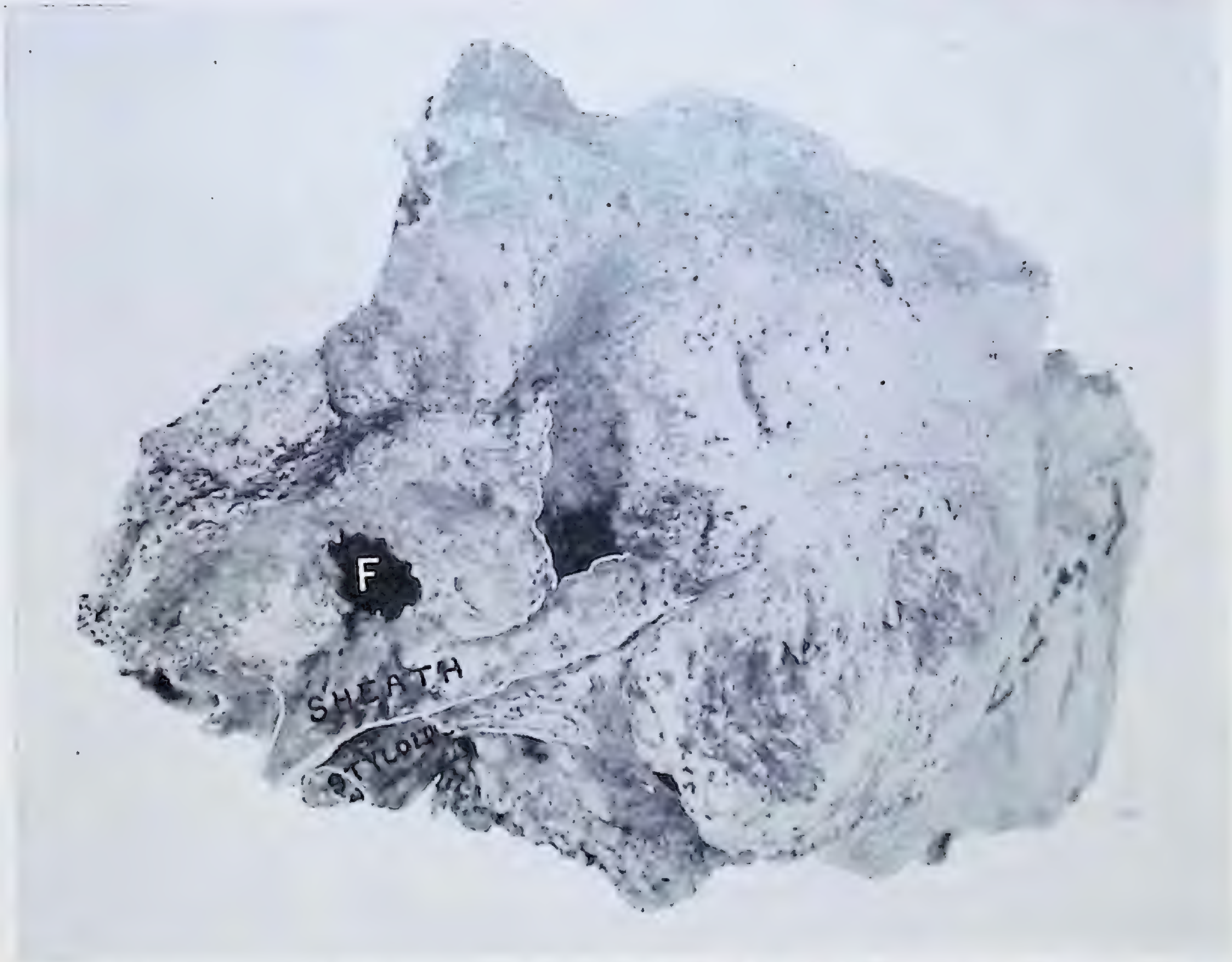
Krogman (1932) studied 183 Australian skulls and found perforated tympanic plates in 7 per cent of females and 6 per cent of males.

Sullivan (1922) examined New World crania for the presence of perforations in the tympanic plate. In his series, there is considerable discrepancy in sample size, and there are no data concerning archaeological context. He reports an incidence of 36 to 55 per cent in skulls from Peru and Bolivia, 1 to 15 per cent in Eskimo, zero to 9 per cent in Salish crania, 12 per cent in Haida, and 7 per cent in Utah Basket Makers. Although he does not describe the sample size or archaeological horizon, he states that the tympanic plate was not perforated in the skulls he examined from Ohio, Illinois, Michigan, the Plains area, Tennessee, Florida, Virginia, Washington, and Arizona.

Hooton (1930) found an over-all incidence of 16 per cent in males and 24 per cent in females in the skeletons at Pecos in northern New Mexico, a Pueblo site occupied from about A.D. 1300 to A.D. 1838.

Snow (1948) reports 27 per cent in males and 42 per cent in females from the Indian Knoll shell mound located in Western-central Kentucky dated at 5302 years B.P. and belonging to the Eastern Archaic Period.

Laughlin and Jørgensen (1956) have found this dehiscence in 26.6 per cent of the males and 35.5 per cent of the females in a large series of Greenlandic Eskimo crania.



An adult left temporal bone with a persistent foramen (F) in the floor of the auditory canal. Well shown is the sheath for the styloid process.

In the 193 adult temporal bones from the Fairty site, studied by the author, a foramen is present in 57, seven have tiny pinhole apertures, nine exhibit an open cribriform area, and two have unformed tympanic plates. The number of temporal bones with defects in the tympanic plate is 75, or 39 per cent.

SUMMARY

1. The tympanic plate develops in the following manner:
   - (*a*) Formation of a tympanic ring which fuses to the temporal bone.
   - (*b*) The floor of the auditory canal forms by backward growth of the anterior limb of the tympanic plate and subsequent lateral extension.
   - (*c*) The posterior limb of the tympanic ring grows downward to form an anterior sheath for the styloid process.
2. A defect in the floor of the auditory canal persists in 39 per cent of adult temporal bones from the Fairty Iroquois ossuary.
3. The incidence of a defect in the tympanic plate varies from zero to 55 per cent in different populations studied. It is presumably due to a genetically determined error of ossification.

ACKNOWLEDGMENTS

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ANOMALIES AND PATHOLOGIES OF THE SADLERMIUT ESKIMO VERTEBRAL COLUMN

By Charles F. Merbs and William H. Wilson[1]

The Sadlermiut Eskimos of Southampton Island and vicinity, because of their peculiar cultural position in the Canadian Arctic, have evoked considerable attention on the part of anthropologists. Our earliest information about these Eskimos comes from Captain G. F. Lyon, an explorer who contacted a small group of them on Coats Island[2] in 1824 (Lyon, 1825). In subsequent years the Sadlermiut were contacted by whalers who worked in the area, but on the whole these men were not inclined to record their observations. Since the extinction of the Sadlermiut in 1902–03, much work pertaining to them has been done by archaeologists through the questioning of informants who had lived with the Sadlermiut for a time and through the excavation of sites belonging to them as well as to earlier occupants of the island. A general background on the archaeology and ethnology of the Sadlermiut can be obtained by reading the pertinent publications of Parry (1824), Lyon (1825), Boas (1888, 1907), Low (1906), Comer (1910), Munn (1919), Mathiassen (1927), Sutton (1932–36), Ferguson (1938), Manning (1942), Holtved (1944), Bird (1953), Collins (1956a, b, c; 1957a, b; 1958), and Taylor (1959, 1960).

Of particular interest is the well-documented record of the final disappearance of the Sadlermiut Eskimos. Captain George Comer, who maintained a whaling station on the island in the early 1900's, reports that the last group of these Eskimos, the Native Point settlement, numbering 57 individuals, perished during the winter of 1902–03 (Comer, 1910). The cause of this extinction has been variously recorded as typhoid fever, typhus, food poisoning from the flesh of a blue whale, scurvy, and starvation. The last possibility was discarded by Mathiassen who, with details from his informants, says that the meat caches had been amply supplied (Mathiassen, 1927).

As a result of published reports and private conversations concerning the relative abundance of Sadlermiut skeletal material at the Native Point site and the desirability of doing a detailed study of this material, a field expedition, under the supervision of Dr. William S. Laughlin of the University of Wisconsin, went to Southampton Island with the expressed purpose of recovering skeletons.[3] During the course of the 1959 summer, the Wisconsin field party excavated over 150 skeletons from the Native Point area as well as six skeletons from Prairie Point on Southampton Island and four skeletons from the Timani site on Coats Island. Another small group of skeletons, recovered in 1956 by Mr. William Taylor (1960) from house ruins at Native Point, was added to the general series from that site for the purpose of this study.

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[2] At the time of Lyon's contact, Coats Island was thought to be continuous with Southampton Island. He, therefore, records the contact as having taken place on Southampton Island.

[3] Recovery and subsequent analysis of the skeletal material were supported by National Institutes of Health Grant R.G. 6321 and the Graduate Research Committee of the University of Wisconsin. Members of the 1959 Field Party included William S. Laughlin, Chester S. Chard, and Charles F. Merbs, of the University of Wisconsin; James VanStone of the University of Toronto and Ralph Chown of Winnipeg, Manitoba.

The skeletal material from the Native Point area fell into three general categories, an early "village" series, an intermediate "peripheral" series, and a late "meat cache" series, the last thought to represent the Sadlermiut who died during the winter of 1902–03. The material recovered from the house ruins (Taylor, 1960) would fall into this last category. Because of the probable overlap between these series and the relatively short time duration represented, it was thought that an intra-group comparative study would be of little value. A possible comparison between the oldest and most recent series was ruled out because of the small number of "village" skeletons available for study. As expected, a comparison between "peripheral" and "meat cache" skeletons yielded no significant differences. It has therefore been omitted from this study.

It is hoped that information obtained from the general analysis of Sadlermiut skeletal material, of which this study is a part, will fill gaps that exist in the physical record of the Central Canadian Eskimos, and at the same time supply detailed information on the physical anthropology of a little known but extremely interesting Eskimo isolate. To date, the analysis has resulted in reports on demographic aspects (Laughlin, *et al.*, 1960), pelvic ossification (Wilson, *et al.*, 1960), general vertebral observations (Merbs, *et al.*, 1960), and burial practices (Merbs, 1960) of the Sadlermiut.

A series of 72 individuals, each represented by a complete vertebral column, was used in this study. The series was subdivided into three separate groups: (1) 58 adults (27 males, 31 females), who could be aged and sexed with a high degree of probability; (2) three adults (1 male, 2 females), who could not be properly aged because of the condition of the cranium and pelvis; and (3) 11 adolescents and children. The last two groups were used only in ascertaining the frequencies of the various pathologies and anomalies for the population as a whole.

The partition between adults and adolescents was based upon the closure of the spheno-occipital suture which preceded the formation of dorsal margins and ventral bevelling on the symphyseal face of the pubis (Todd, 1920). Complete closure of the spheno-occipital suture in the Sadlermiut appears to occur at age 18. This agrees closely with the data compiled by McKern and Stewart (1957, p. 35).

The adults were then aged according to the degree of closure of the calvarial sutures. These sutures were appraised only endocranially with the results based on the work of Todd and Lyon (1924) (modified for use in this laboratory). Judgment of the phase of the metamorphosis of the symphyseal face of the pubis was made independently of the compilation of data on suture closure. The method utilized was primarily the component formula of McKern and Stewart (1957, p. 85), though Todd's (1920) pubic phases were also noted.[1] Where major discrepancies between these three methods existed, the entire skeleton was examined, and in all cases the dilemma was resolved.

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[1] In a very important study utilizing a Mongoloid population, Hanihara (1952) modified Todd's (1920) phases; however, McKern and Stewart (1957) have incorporated this study into their latest work.

The pelvis and cranium were independently utilized to determine the sex. In only one case was there a conflict between the pelvis and the cranium. This individual was classified as a female on the basis of the pelvis which possessed a typically female sciatic notch outside the range of variability for males (Hanna and Washburn, 1953).

TABLE 1. *Age at death by sex*

	Number of individuals	Mean age (years)	Percentage distribution at ages				
			19–25	26–30	31–35	36–40	41–50
Males.......	27	34.3	7.4	40.7	7.4	18.5	30.0
Females.....	31	35.5	12.9	12.9	16.1	35.5	22.6

SPINA BIFIDA

Morphologically, spina bifida is a non-fusion of the developing halves of the posterior vertebral arch. The condition is congenital and is often associated with other congenital abnormalities including maldevelopment of the spinal cord and the brain. In the living person, masses of fibrous, fatty and muscle tissue, located in or near the bony defect, may by extension interfere with the function of the nervous structures underlying the cleft (Dittrich, 1931). The condition is lethal only when extensive.

Spina bifida has been artificially induced in frogs by the treatment of fertilized eggs with lithium chloride and sodium chloride, and by killing small areas of fertilized eggs with ultraviolet light. This produces a retardation of the backward growth of the dorsal lip of the blastopore, causing the two lateral halves of the neural tube to fail to fuse (Gates, 1946, p. 487).

According to Stern (1960, p. 116), spina bifida often occurs in the same individual with anencephaly. Both abnormalities may be found in different members of a sibship or kindred, and Stern suspects that either of these developmental errors are variable expressions of the same homozygous genotype carrying the lethal alleles. This interpretation is based on roentgenograms of the seemingly unaffected parents of defective children, many of whom show that at least one parent had defects of the spine.

In the Sadlermiut vertebral column, spina bifida was limited to units T-11, L-5, L-6, and S-1. Although the laminae of S-1 usually fuse about ages 14 to 15 in Eskimo groups, occasionally they remain unfused into middle adulthood. Of the 11 columns of Sadlermiut children and adolescents examined for the condition, four were younger than age 14 (all with laminae of S-1 unfused), six were age 14 to 15 (4 with fused and 2 with unfused laminae), and one was age 17 (fused laminae). In the adult columns, spina bifida of S-1 (in one instance L-6, a lumbarized sacral unit—*See* Plate VIII A) occurred with a frequency of 25 per cent (7/28) in males and 3 per cent (1/33) in females. Two distinct variations of the condition were noted: "type A" in which the laminae were of normal adult size but had failed to meet, one being superior to the other; and "type B" in which one or both laminae were not fully developed. Type A, accounting for four of the eight cases of S-1 spina bifida, was limited to individuals of age 30 or less and appeared to be attributable to asymmetry of the sacra of the affected columns. In three of these four cases, the left lamina was superior to the right, while in the fourth the reverse was true. All adult columns were subsequently examined for asymmetry of the S-1 laminae, with moderate to marked asymmetry being found in 59 per cent (36/61) of the sacra. Of these, 78 per cent (28/36) had the left lamina superior to the right. Type B spina bifida of S-1 was found in the sacra of four adult columns, all individuals over the age of 30. In each case, the laminae of the affected unit, although not fused to each other, were solidly fused by a secondary growth of bone from their inferior aspects to the remainder of the posterior neural wall.

Among the 11 columns of Sadlermiut children and adolescents, spina bifida of L-5 was found in three individuals aged 5, 6, and 8. It appeared in only one adult, a male of age 29. In the case of the three younger individuals, the general appearance was the same, a distinct cleft in the midline between the laminae which were symmetrical and of normal size for the age of the individual. In the adult, the cleft occurred to the right of the midline and closely resembled the condition as it appeared in T-11.

Four examples of spina bifida of T-11 were observed, two of these with the cleft occurring to the left of the midline, one to the right of the midline, and one directly in the midline. The individuals affected were two children of ages 6 and 7 (right and left), an adolescent of age 13 (midline), and an adult female of age 25 (*See* Plate VII B). In those cases where the cleft was to the right or left of the midline, the spinous process had otherwise undergone normal development. In the 13-year-old, however, the occurrence of the cleft directly in the midline appears to have suppressed the development of a spinous process. One other example of a vertebra with a missing spinous process was observed, but in this case the condition was not accompanied by a cleft. The individual involved was an adult female of age 40 (*See* Plate VII B). The particular unit affected (also T-11) and the general appearance of the arch indicate that spina bifida with a cleft in the midline had been present at an earlier age but had corrected itself.

In the Sadlermiut material, spina bifida, with the exception of S-1 type B, is limited to younger individuals. This appears to be due not only to the selective disadvantages of the condition, but also to the fact that the condition often corrects itself with age. Indeed the latter emerges as the more important factor if one considers the many cases of corrected and apparently corrected cases (including S-1 type B and the missing spinous process) contained in the collection.

Because of the age factor and the different manifestations of spina bifida, it is difficult to make comparisons between the Sadlermiut and the Alaskan Eskimo studied by Stewart (1932). From his description, there appears to be no significant difference in the incidence of the condition in the two groups. Spina bifida does appear, however, to be more frequent in African material where 18.2 per cent of 82 Bantu columns (Shore, 1930) and 10.0 per cent of 206 East African columns (Allbrook, 1955) exhibited the condition. Although the results are somewhat confused because of the different criteria used by different workers, adult American Whites have one of the lowest frequencies of spina bifida, approximately one per cent.

The regional distribution of spina bifida appears to be similar for Aleuts (observations by the authors on material at the University of Wisconsin), Alaskan Eskimo (Stewart, 1932), and Sadlermiut Eskimos. The units affected most frequently in these groups are T-10, T-11, T-12, and the last lumbar vertebra. One of the few exceptions is a Yukon male which had a separation of the neural arch of C-3. Such a distributional pattern contrasts sharply with that of other groups such as the East African material in which the upper lumbar, upper thoracic, and upper and lower cervical regions also exhibit spina bifida. C-1 accounts for the largest proportion of cases (40%) in the East Africa vertebral column.

MALFORMATION OF THE CENTRUM

A congenital malformation of the centrum in the thoracic region was also found in the Sadlermiut material. Case studies on the subject appear to be relatively rare, but those that do exist indicate that the condition is usually present in conjunction with other developmental abnormalities of the spine. Peabody (1927) reports on an interesting case involving an infant in which a malformation of centra T-6 to T-12 was accompanied by the fusion of certain vertebrae and ribs, spina bifida of L-4, and lumbarization of S-1. Congenital malformations of the centrum in adults, depending upon their severity, are accompanied by pain in the region of the defect. Such pain is aggravated by activity, especially lifting (Fischer and Vandemark, 1945). In cases where the defect consists of a complete sagittal cleft in the centrum, continued aggravation usually results in lateral displacement (butterfly vertebra) or a premature compression fracture of the vertebral body.

According to Ehrenhaft (1943), malformation of the centrum can be attributed to a persistence of the ventrodorsal extension of the perichordal sheath. Morris (1953, p. 112) also refers to the nucleus of the developing centrum as becoming bilobed with the condition sometimes being so pronounced as to give rise to two distinct nuclei. Each half of the centrum then undergoes separate ossification with variable persistence of a sagittal cleft. Another manifestation of the condition is the occasional formation of half-vertebrae (Morris, p. 112, 1953).

In the two children affected in the Sadlermiut material, the anomaly appeared in a very distinctive form: T-8, a cleft extending from the neural canal to the centre of the body; T-10, a portion of the centrum missing; and T-11, spina bifida (*See* Plate VII A). In one of these children (age 6), a large anterior portion of the centrum was missing, the defect being of sufficient magnitude to leave the neural canal without an anterior bony wall. In the other child (age 7), the defect was in the posterior part of the centrum of T-10 but was smaller, so that the neural canal remained intact although enlarged in its antero-posterior diameter. A malformation of the centrum was found in 4.9 per cent (3/61) of the adult columns examined. In only one of these, a male of age 30, was more than one unit affected. In this individual T-5 lacked a small posterior and T-8 a larger anterior portion of centrum. In neither affected unit was the defect extensive enough to destroy the continuity of the centrum. The other affected adults were a female of age 37 with a large anterior section of the centrum of T-7 missing, the anterior neural wall again being incomplete (*See* Plate V B), and a male of age 33 with a smaller anterior portion of T-8 missing with the neural wall remaining intact

From a study of the Sadlermiut material, it would appear that the condition, when present as a cleft, appears to correct itself with age. When a portion of the centrum is absent, however, premature compression fractures result, the severity of the fractures dependent upon the severity of the original malformations (*See* Plate VI). No indications of lateral displacement were noted.

Spondylolysis

The condition spondylolysis (or spondyloschisis) is characterized by a unilateral or bilateral break in the continuity of the neural arch, usually between the superior and inferior articular processes. If the two component parts of an anomalous vertebra become separated by a forward displacement of the body while the articular processes retain their position, the resulting condition is called spondylolisthesis. In the living, fibrous connective tissue bridges this lesion or it contains a false joint. Afflicted persons usually complain of pain in the lower back which is increased with lifting or gain of weight.

According to Stewart (1931), spondylolisthesis was diagnosed in the early days only in the course of pregnancy since the condition constituted an obstruction to the birth canal. Naturally, therefore, the condition seemed to be limited to women and was rarely discussed outside the gynecology literature. Later the condition was found to occur with even greater frequency in males.

Among the first to describe the variation and to give an account of its morbid anatomy was Kilian (1854), who posed the important etiological question of whether the lesion was a congenital ossification deficiency or a defect acquired as a stress fracture. The problem was an intriguing one which elicited many diverse opinions, most of which are reviewed by Wiltse (1957). Attempts to produce fracture at the pars interarticularis in the lumbar vertebrae of stillborn infants were unsuccessful and tended to discount the theory that the lesion was due to prenatal fracture. Lesions in other parts of the neural arch attempt to heal, and the only reported instance of traumatic fracture at the pars interarticularis (Roche, 1948) also healed. Microscopic analysis has failed to discover any asceptic necrosis, cyst formation, or laking of blood in defective parts (Wiltse, p. 52, 1957).

Although much remains to be known about the etiology of spondylolysis and spondylolisthesis, certain facts have been established. Among these are the following: That the incidence is zero at birth and increases to adulthood; that there is considerable racial variation; that males are afflicted more often than females; that the slip occurs shortly after the appearance of the defect and increases thereafter only in rare cases; and that the condition appears to be familial. The familial nature of the condition was established by Wiltse (1957), who conducted consanguinity studies on 24 families in which the initial patient had a defective pars. After exclusion of the probands, the incidence of defective pars was over 31.3 per cent as compared to 5 per cent in the general population. The trait thus appears to be familial, but whether it is dominant or recessive is unknown as is also its degree of penetrance. It is not sex-linked, however, and the greater weight of evidence is on the side of its being recessive.

The extensive work of Stewart (1931) and others indicates that the Alaskan Eskimo has the highest incidence of spondylolysis of any major racial group. The Sadlermiut exhibited this condition in 14 of 61 (23.0%) adult columns, also a significantly high incidence. Corresponding to the findings in most other racial groups, Sadlermiut males were affected more often than females (males 32.1%–9/28, females 15.2%–5/33). The anomaly was found in only one adolescent and in none of the children.

Spondylolysis was present in the Sadlermiut in a variety of forms, most of which have been extensively described by Stewart (1953). Only units L-1 through S-1 were affected with L-4 and L-5 accounting for 78 per cent of the total. Two columns exhibited the defect in two units, another in three units. The latter, a male of age 45, also exhibited a high development of osteophytosis on the anterior superior border of the sacrum. These osteophytes clearly showed the imprint of the body of L-5 and indicated that a forward displacement of about 15 mm had occurred. Complete separation at the pars was seen in 68 per cent of the defective units and in all cases involved L-4 and L-5 (*See* Plate VA). Pseudo-articular facets were seen on the posterior and anterior aspects of two unilateral defects involving units L-1 and L-2 (*See* Plate VA). A complete separation of the pars on the right side only was seen in L-6, a lumbarized sacral unit belonging to a female of age 24, and a partial separation on the left side of S-1 was seen in a male of age 19. The latter also exhibited type B spina bifida of S-1, the only instance of both defects occurring in the same individual.

In the Alaskan material, the units affected most frequently were also L-4 (28.2%) and L-5 (62.9%), although one example of separation in C-3 was observed (Stewart, 1953). In American Negro and White columns, spondylolysis was also largely confined to the lumbar region, but there were occasional occurrences of it in the cervical region in Japanese and in the thoracic region in East Africans (Allbrook, p. 506, 1955).

VERTEBRAL FUSION

Non-pathological vertebral fusion is best described as a synostosis or clean fusion of the articular facets and occasionally the laminae, transverse processes, and centra. The condition has been fully described in the past, especially as it affects units C-2 and C-3, but its etiology remains unknown. Keith (1923) demonstrated that fusions of vertebrae may result as a part of the complicated anomalies produced by incomplete segmentation in early embryos, but Nayak (p. 400, 1931) thought it more likely that they were due to abnormal ossifications of the capsular and other ligaments during the period of postnatal growth. A genetic basis is likely, but nothing is known about the mode of inheritance.

Although seven of 61 (18.0%) adult Sadlermiut columns contained fused units, in none of these could the condition be called non-pathological with certainty (*See* Plate IV). On the contrary, most of the affected units show signs of osteoarthritis such as the development of osteophytes around the articular facets and ossification of the longitudinal ligaments between the vertebral bodies. Fused units occurred only in individuals of more than 25 years of age. In the age group in which it occurs most frequently and in its regional distribution in the column, vertebral fusion closely resembles osteoarthritis. Columns with fused units show considerably more osteoarthritis (2.5 times as many units affected) than those without the condition. Evidence points to osteoarthritis as having destroyed the diarthrodial articulations with synostoses resulting after healing.

Although apparently rare in all parts of the world, non-pathological vertebral fusion, especially of units C-2 and C-3, has been reported for many diverse groups such as Indians from South India (Nayak, 1931), East Africans (Allbrook, 1955), and Dorset-culture Eskimos (Laughlin and Taylor, p. 13, 1960). The authors also observed it in a Paleo-Aleut child, American Whites, American Negroes, and Orientals.

COMPRESSION FRACTURES

Pathologically deformed vertebrae in which the anterior height of the body was more or less diminished were frequent in the Sadlermiut material, especially in the older individuals. From their distinctive appearance, these cases are thought to represent compression fractures rather than other pathologies often mistaken for them. Because the fulcrum of motion in a compression fracture is in the joints of the vertebra, the body takes on a wedge-shaped appearance. Except in extensive compressions, only the upper half of the vertebral body is affected (*See* Plate VIII B). Sections of affected vertebrae showed the spongy bone of the compressed area of the centrum to be more dense than the unaffected portion.

According to Ellis (1944) the vectors of force which act in the compression of a vertebral body are principally dependent upon the anatomy and integrity of the neural arches which form the fulcrum of motion, upon the direction and configuration of the articulations of the arch determining the amount of motion occurring at this fulcrum, and upon the direction of dissipation and violence of this compressive force when applied to the resilient nucleus pulposus. The greatest pressure of a forward-bending motion is received by the vertebrae of the thoraco-lumbar junction. In this area the intervertebral spaces become wider, and the amount of movement of each vertebra on the one below becomes greater because of the size of the nucleus pulposus separating the bodies. Although the etiology of the condition is unknown, some observers have noted a tendency toward herniation into the vertebral bodies preceding the compression fracture. Herniation would diminish the intervertebral space and damage the anterior portion of the centrum where the increased pressure load would become concentrated (Ellis, 1944).

In the Sadlermiut vertebral column, compression fractures were limited entirely to adults over the age of 24. Eliminating compressed vertebrae resulting from normal stress on malformed centra, 33 of 61 (54.1%) adult columns had at least one fractured unit. A more severe condition, in which at least a third of the thoraco-lumbar units was affected, was limited almost entirely to individuals between the ages of 35 and 50. The condition in its most intense form was found in a female of age 37, in which 12 of the 17 thoraco-lumbar units showed some degree of wedging.

There appeared to be little difference between males and females in regard to susceptibility to compression fractures, although females exhibited the condition with greater intensity, especially in the older age categories.

Compression fractures were limited entirely to the thoraco-lumbar region of the Sadlermiut vertebral column, with the regional distribution the same for males and females (Figure 1). Often the surfaces of fractured units as well as those immediately above them exhibited large pits probably due to herniations, osteophytes, and osteoporosis. However, the correlation of any of these conditions was higher with osteoarthritis than with compression fractures.

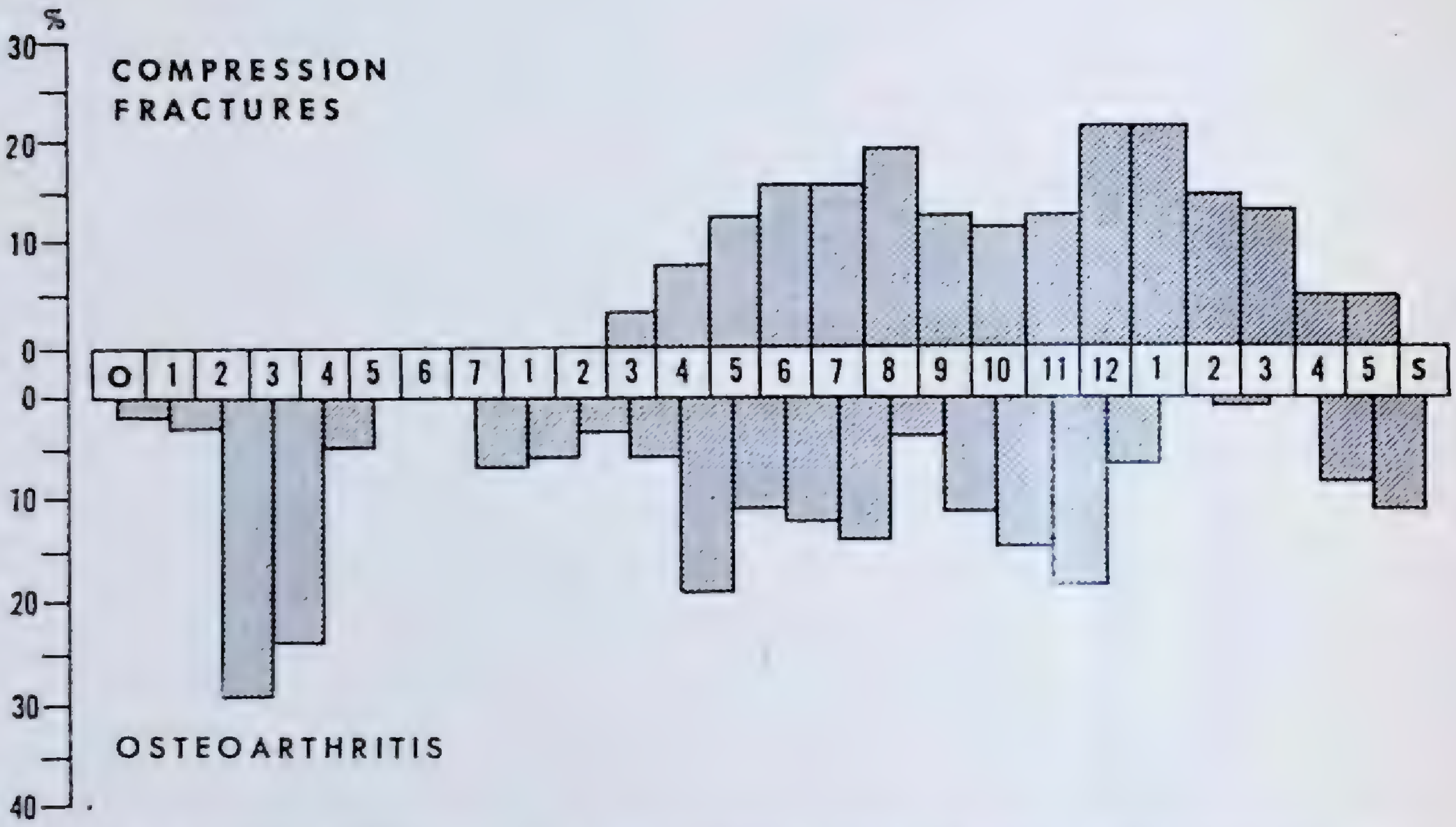

FIGURE 1. Regional distribution of compression fractures and osteoarthritis in the adult Sadlermiut vertebral column. Indicated are the percentages of particular vertebral units showing compression fractures of the body (above) or signs of osteoarthritis on the articular facets of the intervertebral joints (below) (Total series—61 columns).

LAMINAL EXOSTOSES

In 1912 Le Double described certain bony spurs arising from the inferior aspect of the dorsal arch of thoracic vertebrae. Utilizing evidence from comparative anatomy, he called the spurs an atavistic characteristic representing the zygantrum (actually the zygosphore) of reptiles. Shore (1931) also described the spurs together with what he believed to be related exostoses of the superior aspect of the dorsal arch. Discounting Le Double's theory, he attributed the condition to a pathological ossification of the ligamenta flava resulting from separation of the vertebral arches and the corresponding strain on the ligaments. Dissecting the lower part of a vertebral column, Shore found superior and inferior exostoses within the interlaminal ligaments.

Ossifications of the ligamenta flava arise from the superior and inferior borders of a smooth chevron-like area (point directed downward) on the anterior surface of the arch. The inferior exostoses originate at the junction of the attachments of the interlaminar and capsular portions of the ligamenta flava. They are usually situated anteriorly and rather medially to the inferior articular facets and are separated from them by distinct intervals. The exostoses of the superior laminal borders occur as a series of spicules (Plate III B), usually larger and more numerous near the superior articular facets. In a few instances, the Sadlermiut exhibited a single inferior spur in the midline rather than the usual bilateral condition. However, there were no examples of fused vertebrae owing to a coalescing of the superior and inferior exostoses such as that recorded by Shore (1931).

Of the 61 adult Sadlermiut columns examined for laminal spurs, 49 (80.3%) exhibited the condition. Males were affected more frequently than females, especially on the inferior margins of the laminae (males 86%–24/28, females 52%–17/33). The regional distribution of the condition was similar in both sexes with exostoses of the superior border found on units T-2 through L-4 and those of the inferior border on units T-2 through L-2 (Figure 2).

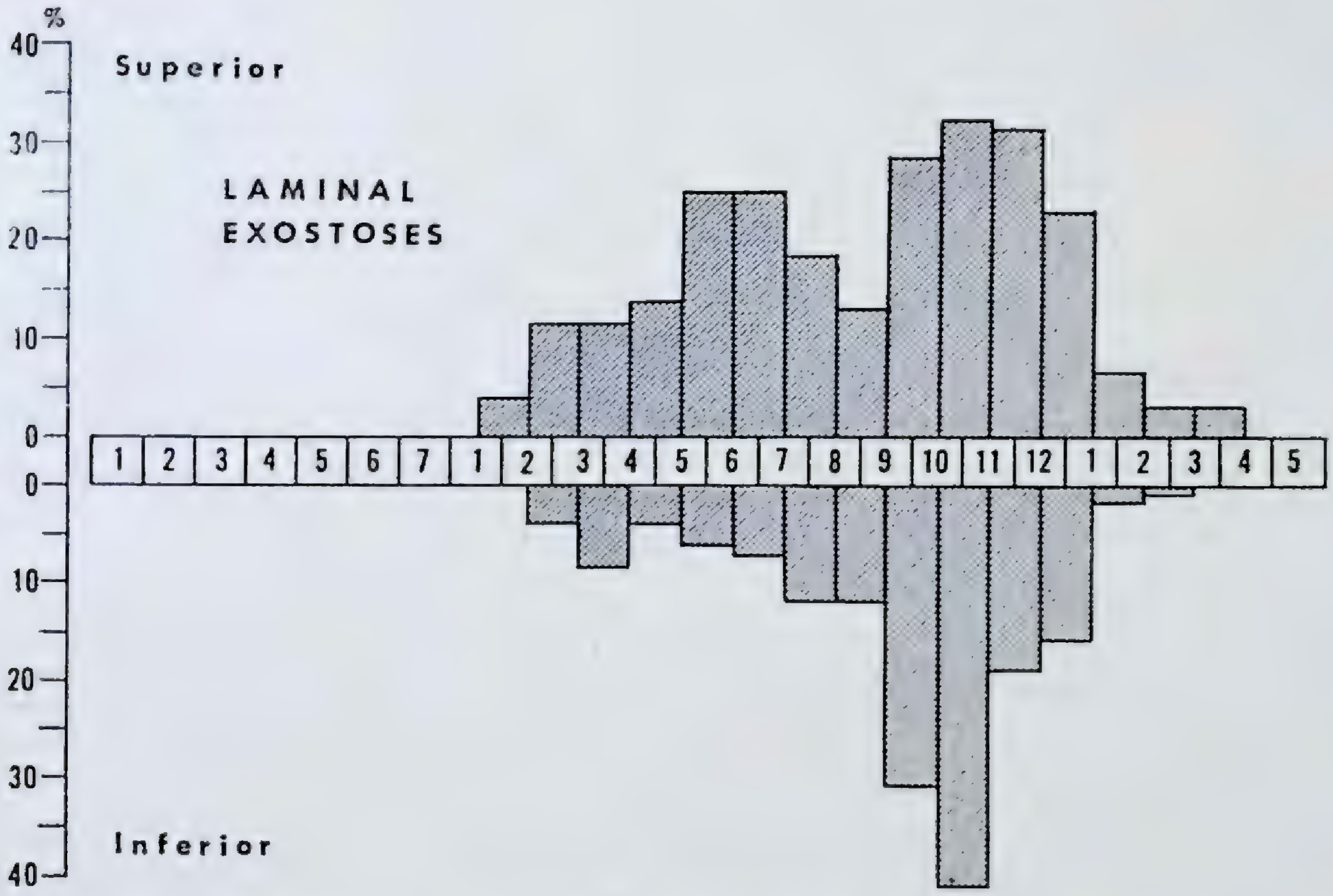

FIGURE 2. Regional distribution of laminal exostoses in the adult Sadlermiut vertebral column. Indicated are the percentages of particular vertebral units in which the ligamenta flava have begun to ossify from the superior or inferior margins of the laminae (Total series—61 columns).

In correlating the condition with age, the greatest number of units were affected in males from 31 to 35 years of age and in females from 26 to 30 (Table II). The most intense development of laminal exostoses (53% of all possible thoraco-lumbar sites affected) was seen in a 26-year-old female.

In both regional distribution and units most frequently affected, laminal exostoses in the Sadlermiut closely resemble those reported for the Bantu (Shore, 1931). A lower percentage of adult Bantu columns were affected (62%), but the difference may be due to variables not considered. McKern and Stewart (1957) examined the vertebral columns of 367 male adults, 90 per cent of which were American Whites. Recording only superior exostoses, they discovered a distributional configuration similar to that found in the Sadlermiut. On regrouping their data into the age categories used in this report, the authors find that these American White columns show in every category a considerably higher percentage of units affected than in every category of the Sadlermiut. As expected, McKern and Stewart (p. 110, 1957) found laminal exostoses to be more frequent with advancing age, but the amount of individual variation was considerable.

OSTEOPHYTOSIS

Degenerative disc disease and osteoarthritis were found in the Sadlermiut material. Because of the complexity of these conditions and the frequent overlap of their osseous signs, they will be treated only in a general way under the headings osteophytosis, osteoarthritis, and osteoporosis. The first of these, osteophytosis, is a condition which usually results from degenerative disc disease, characterized by a development of osteophytes on the superior and inferior borders of the vertebral bodies. Since the pathogenesis of these changes are similar to those resulting from osteoarthritis, degenerative disc disease has often been referred to as an arthritis although the joints involved are syndesmoses.

The formation of marginal osteophytes is thought to be stimulated by a narrowing of the intervertebral disc and an impairment of its resiliency (Luck, p. 219, 1950). The nucleus pulposus may undergo involution as the result of chronic stress or may be extruded as the result of acute stress (Cordrey, 1960). The narrowed discs lead to malalignment and malposition of the intervertebral joints, thereby altering the joint mechanisms. This usually produces a low-grade pain in the back which is aggravated by activity and relieved by rest. Extensive development of osteophytes may impinge upon the neural foramina and irritate the nerve root or impinge upon each other leading to ankylosis of the vertebral bodies. In size and form the osteophytes seem to be intimately linked with the activity and mechanical stresses to which the joint is subjected.

Osteophytes were found on the edges of vertebral bodies in 46 of 61 (75.4%) adult Sadlermiut columns. Males were affected more frequently than females (males 82%–22/28, females 70%–23/33); the former showing a higher proportion of affected cervical and lumbar units, the latter exhibiting a higher incidence in the thoracic region. The joints affected most frequently in both sexes were C-5/6, T-6/7, and T-7/8, and the lower lumbar joints (Figure 3). Osteophyte development was more intense on the superior aspect of the joint in the region T-2/3 to T-9/10; below this point it was more intense as well as more frequent on the inferior aspect of the joint. Osteophytosis was most prevalent in individuals in the 31 to 35 age category regardless of sex (Table 2).

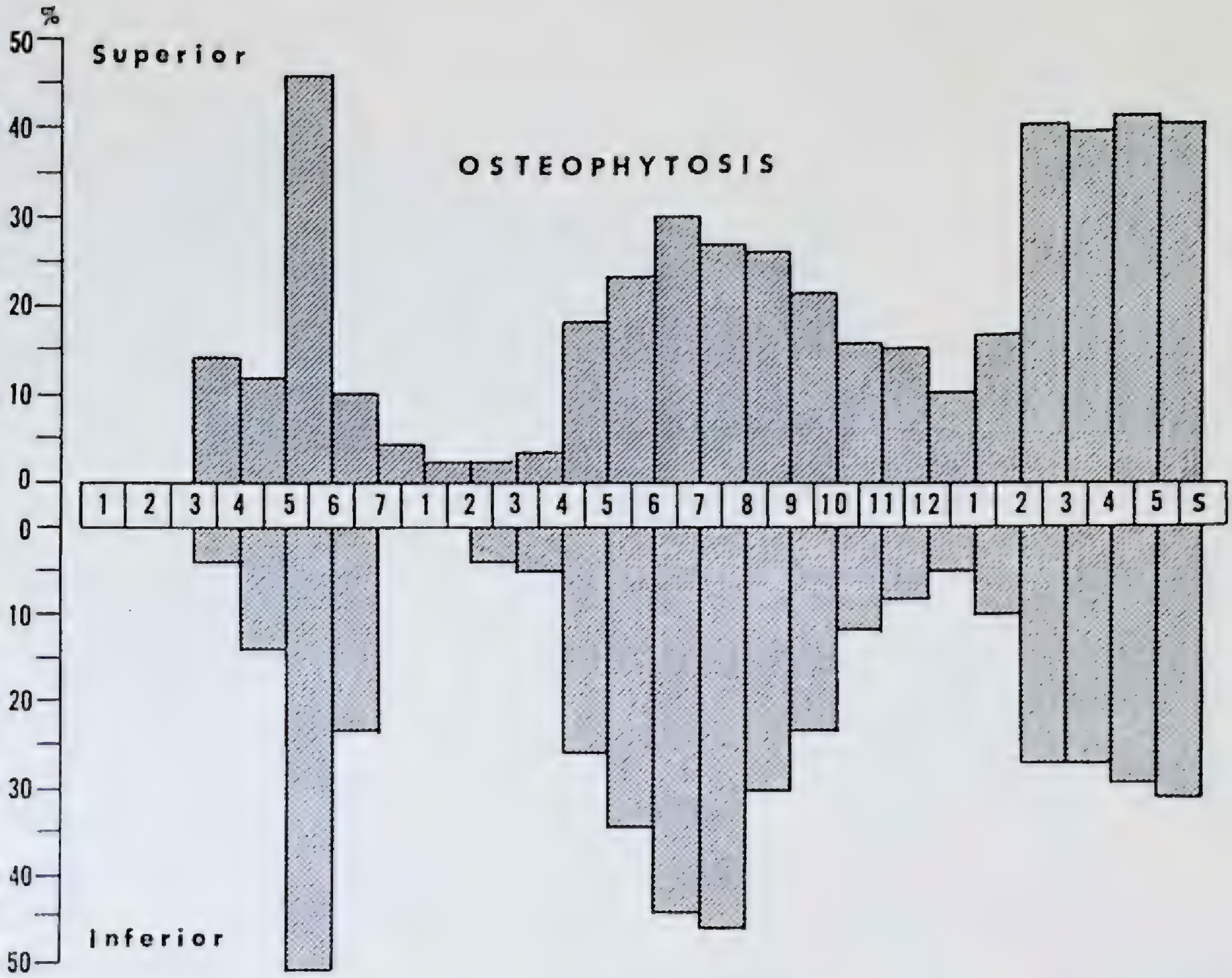

FIGURE 3. Regional distribution of osteophytosis in the adult Sadlermiut vertebral column. Indicated are the percentages of particular vertebral units showing osteophytes at the anterior and lateral margins of the superior or inferior surfaces of the bodies (Total series—61 columns).

Although it is difficult to make racial comparisons for pathological conditions like osteophytosis, especially when the observations are made by different people, some interesting work along this line has been done. Stewart (1947) found the Alaskan Eskimos to have comparatively little lipping anywhere but in the lumbar region, while Pueblo Indians have more lipping in every region. Whites, on the other hand, have maximum lipping in the lower cervical region. Roche (1957) found the incidence of osteophytosis to be slightly higher in Whites than in Negroes. At first, according to Roche, females are affected more frequently than males, but with increasing age the incidence in males comes to equal or exceed that found in females. Using skeletal material from the Korean War and the Terry Collection of Washington University, Stewart (1958) attempted to determine the usefulness of osteophytosis and osteoarthritis in skeletal age identification. As expected, he found a correlation between both an increasingly greater number of units affected and a greater severity of the condition with increasing age. Individual variation was considerable, however. The Sadlermiut material showed even less correlation and greater individual variation than did that of Stewart.

OSTEOARTHRITIS

Although the term "osteoarthritis" is often applied to degenerative disc disease as well as to hypertrophic arthritis of the apophyseal joints, in this report it will be limited to the latter. Osteoarthritis is a degenerative disease generally thought to result from pressure which is too great or sustained for too long a time for a particular joint to bear. A lack of normal intermittent pressure on the cartilage of a joint is also thought to be a primary as well as a secondary cause of the condition. The results of many studies show that osteoarthritis can occur at any age during adulthood, but does reflect the ageing process as it leaves an ineffaceable mark and affects more people successively as age advances (Stecher, p. 168, 1961). Changes in osteoarthritis begin as a general deterioration of cartilage, followed by an erosion of the joint surface which may in turn result in a complete denudation of bone in the areas of pressure. In the non-pressure areas, especially the edges of the joint surfaces, the cartilage is not worn away but usually thickens and begins to ossify. The surfaces of affected joints exhibit a proliferation of blood vessels, characterized by numerous round regular holes which allow blood vessels to penetrate the subchondral bone in order to reach the degenerating cartilage (Stecher, p. 171, 1961). As a result of the articular involvement, pain with consequent limitation of motion may be present (Cordrey, p. 139, 1960), although in clinical work the condition is often found, incidentally, in the absence of symptoms.

In the Sadlermiut skeletal material, osteoarthritis of the apophyseal joints was characterized by a development of osteophytes on the joint edges, and a roughening or eburnation and porosis of the joint surfaces. Occasionally the costovertebral joints exhibit similar symptoms. The effects of osteoarthritis were seen in 44 of 62 (71.0%) adult columns occurring with slightly higher frequency in males (82%) than in females (62%). No sexual differences in regional intensity were detected. The joints affected most frequently were C-2/3 in the cervical region, the mid-thoracic joints with the exception of T-8/9, and the lower lumbar joints (Figure 2). In aged male Caucasians, Francis (1956) found intense cases of osteoarthritis in the cervical apophyseal joints to occur with greatest frequency in C-2/3, C-3/4, and C-4/5; in the Sadlermiut the distribution is similar but with almost the complete exclusion of C-4/5.

Using only those cases in the Sadlermiut material in which the condition was present to a very marked degree, osteoarthritis was found to affect the left side more often than the right, but only in joint C-3/4 (8 left, 3 right). This finding is in general agreement with that of Francis (1956) who found the greatest left-right differences in joints C-2/3, C-3/4, and C-4/5, in a series of 117 aged male White columns. Again, using only those Sadlermiut joints affected to a very marked degree, it was found that those in the cervical region, the upper thoracic region, and the lumbosacral border were affected unilaterally, while those in the lower thoracic region were affected bilaterally.

In general, the Sadlermiut columns showing the most intense development of osteoarthritis and the greatest number of joints affected fell into the 31 to 35 age category (Table 2). The correlation between the incidence of osteoarthritis and that of other conditions, based on the number of joints affected, was about 50 per cent for osteophytosis and osteoporosis of the centrum, and 30 per cent for compression fractures and laminal spurs.

Stewart (1947) found that Alaskan Eskimos had a high incidence of osteoarthritis, especially in the mid-cervical and upper thoracic region. Pueblo Indians, on the other hand, had fewer facets involved, these being mainly in the upper thoracic region. Whites also had minor facet involvement with a regional distribution similar to that for Alaskan Eskimos. In all groups studied (Roche, 1957, and Stewart, 1958) the incidence of osteoarthritis was less than that of osteophytosis. On the basis of this and other evidence, Roche suggested a causal relationship between the two conditions —that the presence of osteophytes may be necessary for the presence of osteoarthritis.

Osteoporosis of the Vertebral Body

Osteoporosis, an abnormal porousness or rarefaction of bone caused by enlargement of its canals or formation of abnormal spaces, was noted on the surfaces of the apophyseal joints as an almost invariable sign of osteoarthritis. The condition also occurred on the surfaces of bodies, often in combination with the development of osteophytes (Plates I B and II A). Because of the greater variability of the condition as it affected the body, it will be treated as a separate entity in this study, although it appears to be closely related to degenerative disc disease, if not a direct consequence of it.

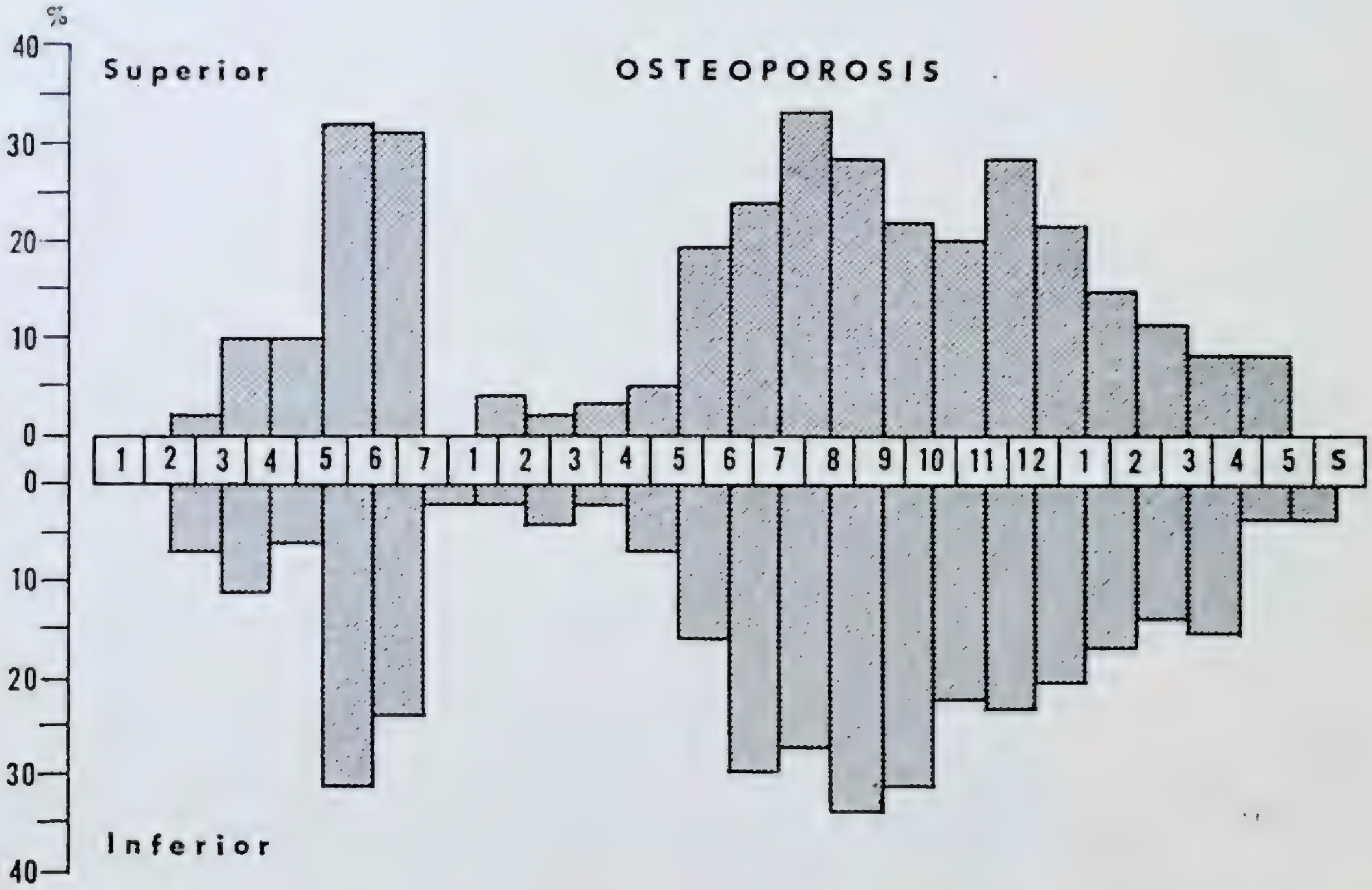

Figure 4. Regional distribution of osteoporosis of the vertebral bodies in the adult Sadlermiut vertebral column. Indicated are the percentages of particular units showing osteoporosis on the superior or inferior surfaces of the bodies (Total series—61 columns).

Osteoporosis of the vertebral body occurred with a frequency of 73.8 per cent (45/61) in the Sadlermiut columns, with males having a slightly higher frequency than females (males 78%–22/28, females 70%–23/33). Its regional distribution in the column is similar to that for osteophytosis, except for the apparent lack of difference in either frequency of occurrence or intensity between the inferior and superior aspects of a joint. Also, osteoporosis is marked by a gradual decline in frequency as one moves inferiorly from the mid-thoracic region, whereas the frequency drops sharply at the thoraco-lumbar junction and rises again in the mid-lumbar region in osteophytosis (Figure 5). The condition affects individuals of age group 31 to 35 with greatest intensity, as was the case with all arthritic-like conditions (Table 2).

TABLE 2. *Sadlermiut vertebral pathologies and age at death*

	Percentage of possible sites* affected at age				
	19–25	26–30	31–35	36–40	41–50
Compression Fractures:					
Males	0	3	7	7	20
Females	4	4	9	13	12
Osteophytosis:					
Males	0	15	58	17	27
Females	3	2	32	21	22
Laminal Spurs:					
Males	3	15	26	17	11
Females	4	25	12	9	6
Osteoarthritis:					
Males	0	9	19	11	10
Females	0	4	17	10	5
Osteoporosis:					
Males	0	7	57	17	19
Females	7	12	20	19	17

*Possible sites for each condition:
Compression fractures—17 (T-1 through L-5).
Osteophytosis—45 (C-2 inferior aspect through S-1 superior aspect).
Laminal spurs—34 (T-1 through L-5, superior and inferior).
Osteoarthritis—50 (Occipital/C-1 through L-5/S-1, right and left).
Osteoporosis—45 (C-2 inferior aspect through S-1 superior aspect).

SUMMARY

1. An isolate of Sadlermiut Eskimos consisting of 61 adult and 11 subadult skeletons was examined for anomalies and pathologies of the vertebral column which were then correlated with age and sex of the individuals involved.

2. Among the conditions found were spina bifida, malformation of the centrum, spondylolysis, pathological vertebral fusion, compression fractures, laminal spurs, osteoarthritis, and degenerative disc disease.

3. Only spina bifida, malformation of the centrum (closely associated with spina bifida), and one case of spondylolysis were found in the subadult columns.

4. The Sadlermiut correspond to other Eskimo groups in having the highest frequency of spondylolysis of any known group.

5. Although non-pathological fusion has been observed in many groups including Eskimos, most cases of vertebral fusion in the Sadlermiut material appear to be pathological in origin.

6. Among the conditions normally associated with ageing, only compression fractures followed the expected trend of increase with age.

7. The other pathological conditions, all arthritic in nature, were found with greatest frequency and intensity in adults of the middle age ranges.

8. It is probably true that the anomalies and pathologies of the Sadlermiut vertebral column exerted selective forces (especially the arthritic conditions), but the nature of the sample (over half of the individuals appear to be victims of the 1902–03 disaster) makes this difficult to quantify.

9. With the exception of compression fractures, for which there is no difference between the sexes, males appear to be more susceptible to the vertebral anomalies and pathologies studied.

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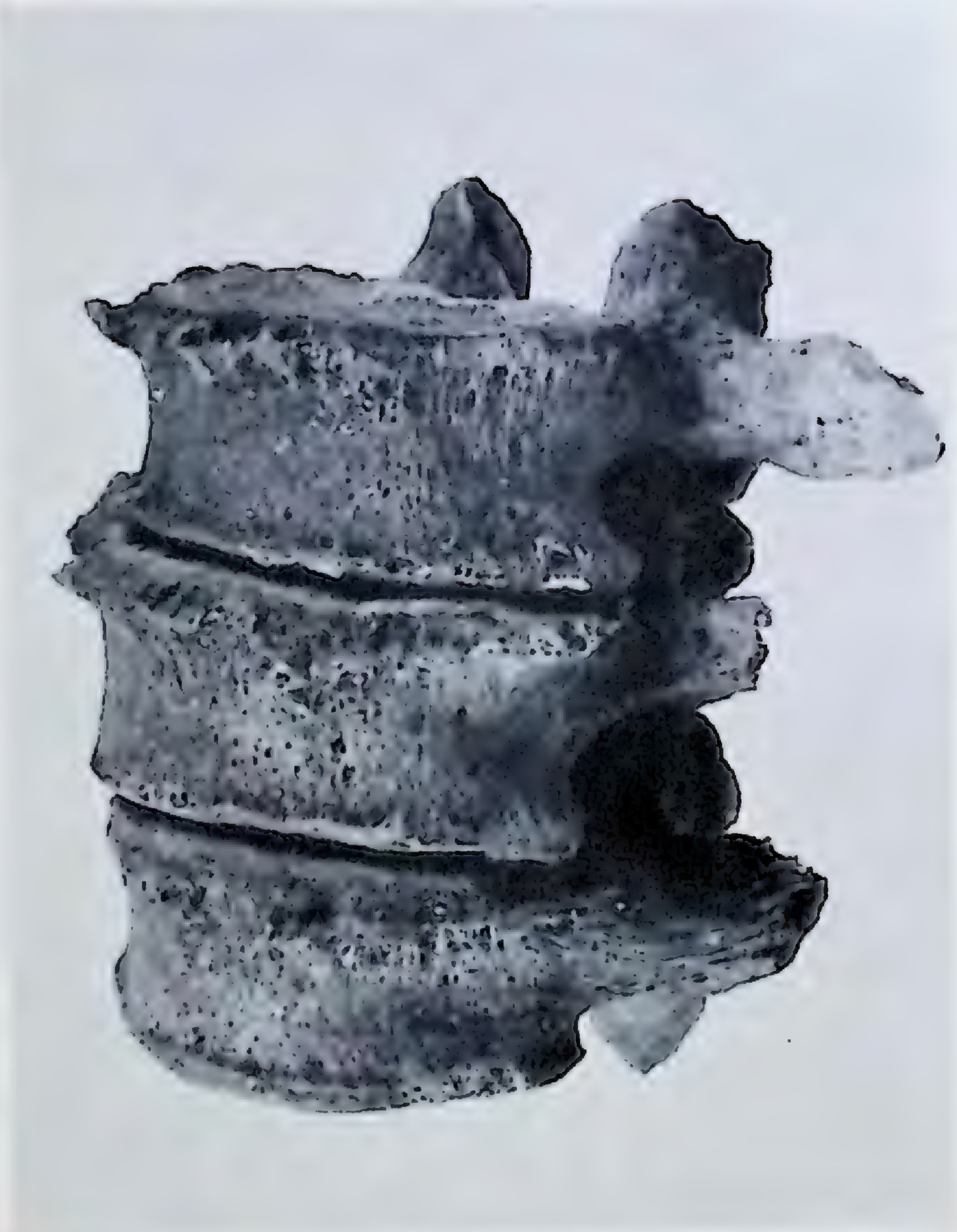
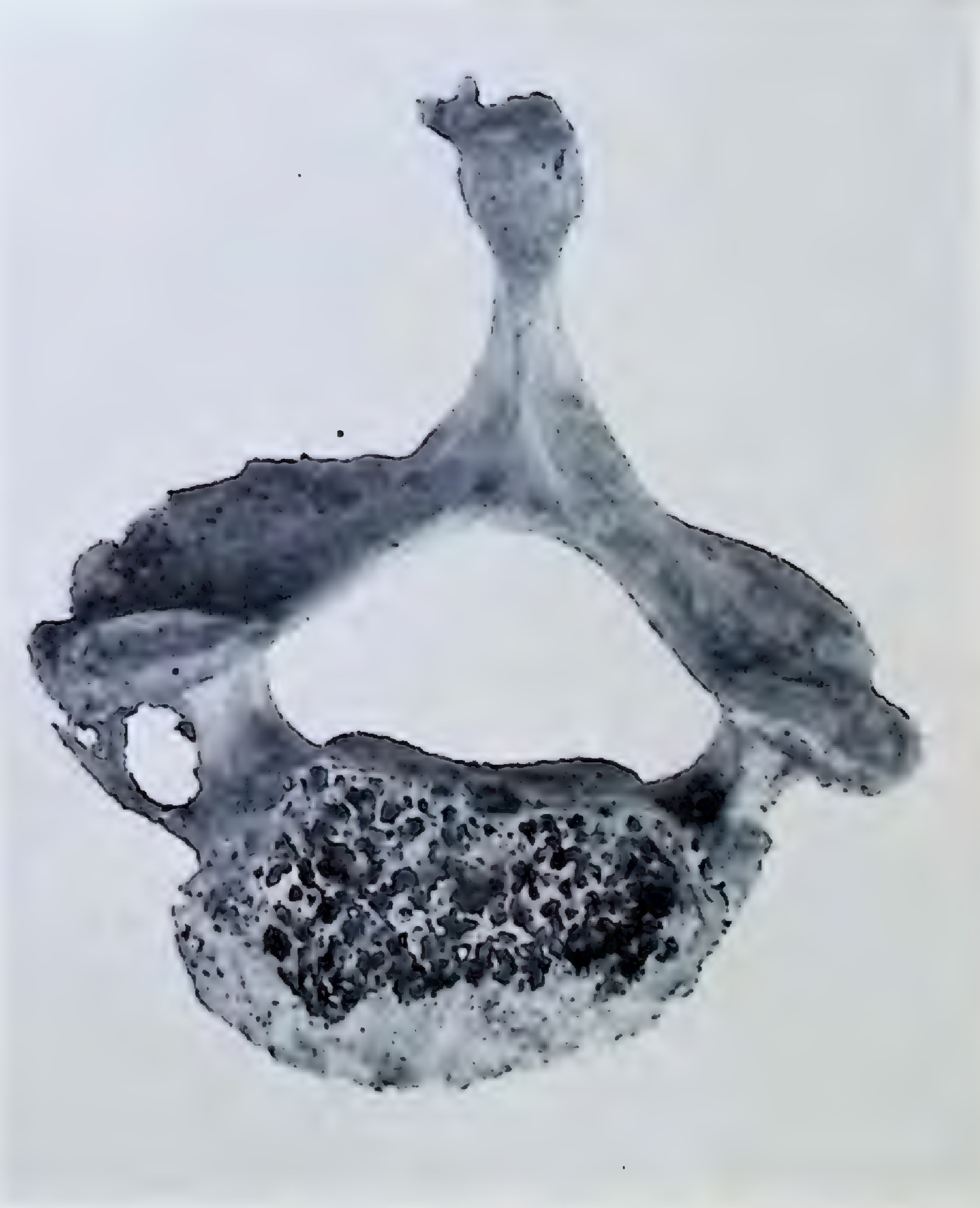
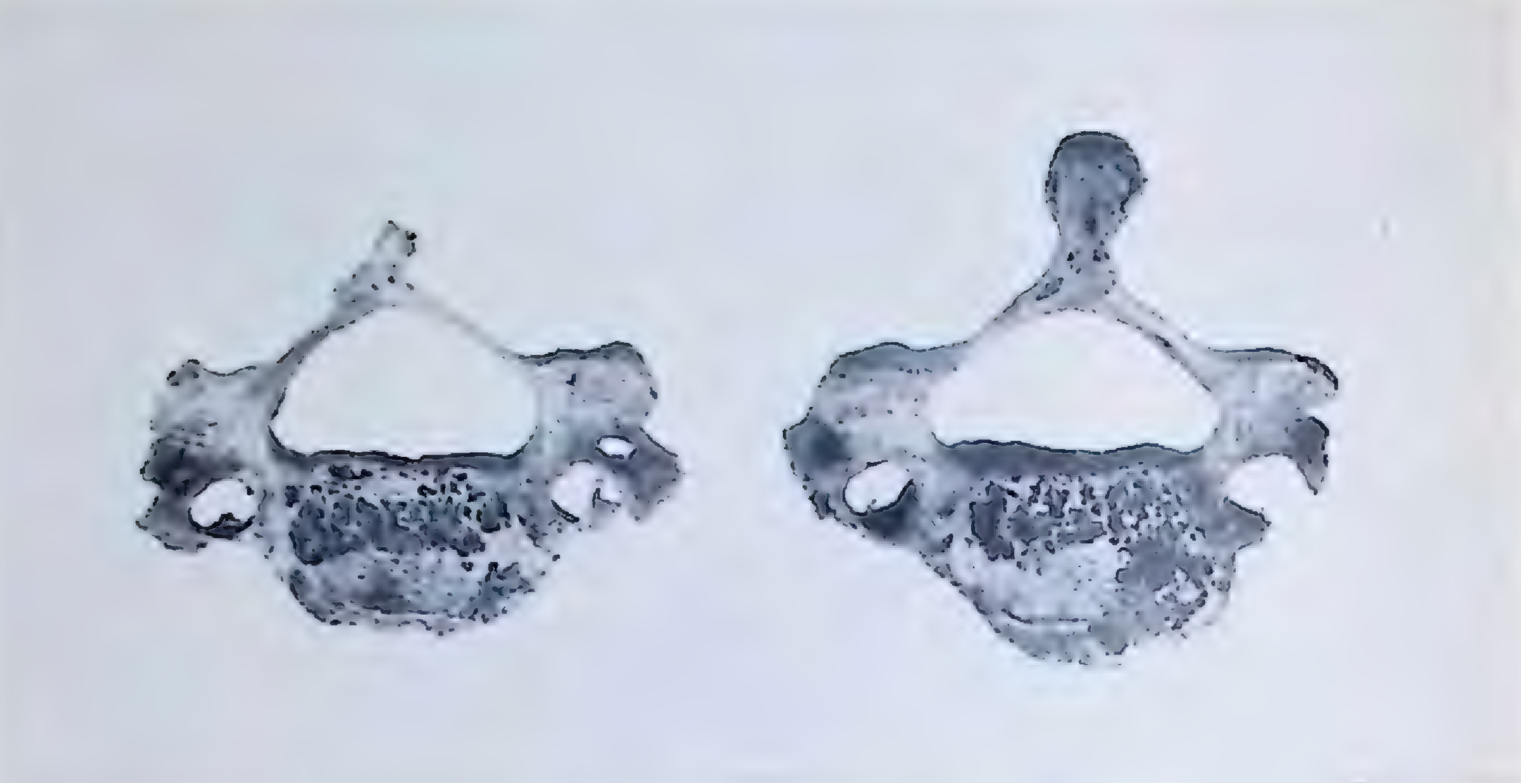
PLATE I



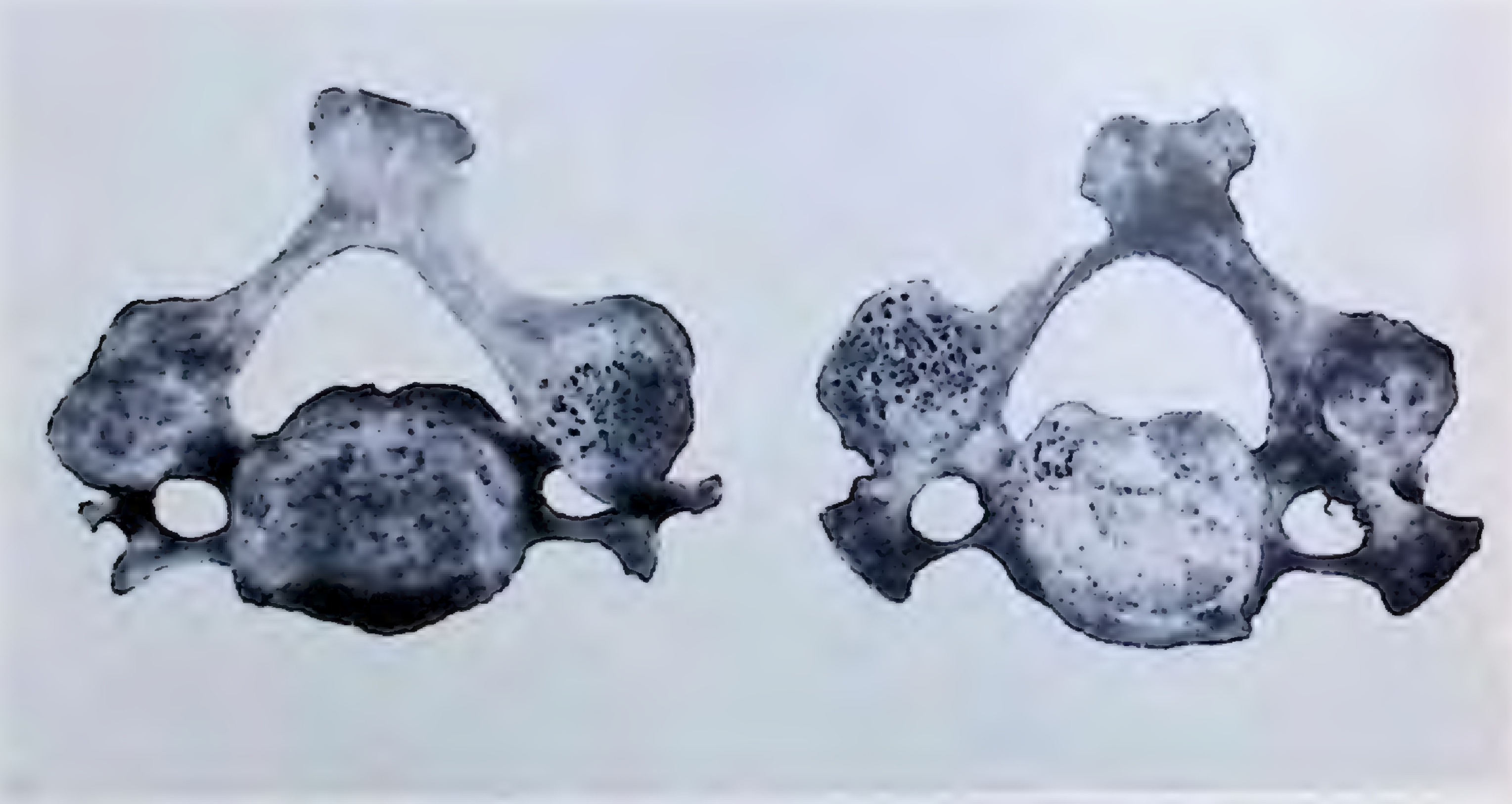
A. Osteophytosis. Third, Fourth, and Fifth Lumbar Vertebrae. Male—Age 41.



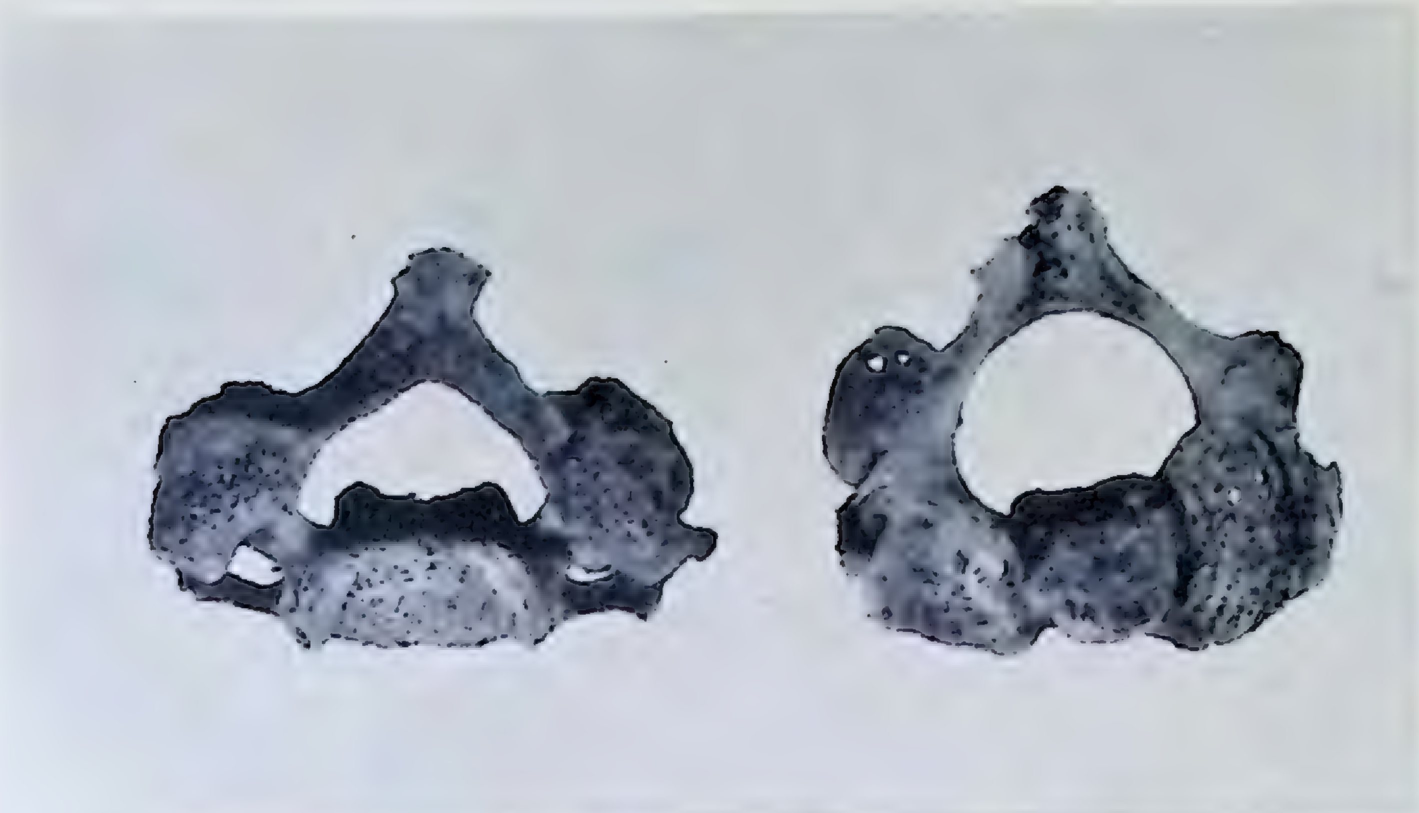
B. Osteoporosis of the vertebral body. Seventh Cervical Vertebra. Male—Age 36.



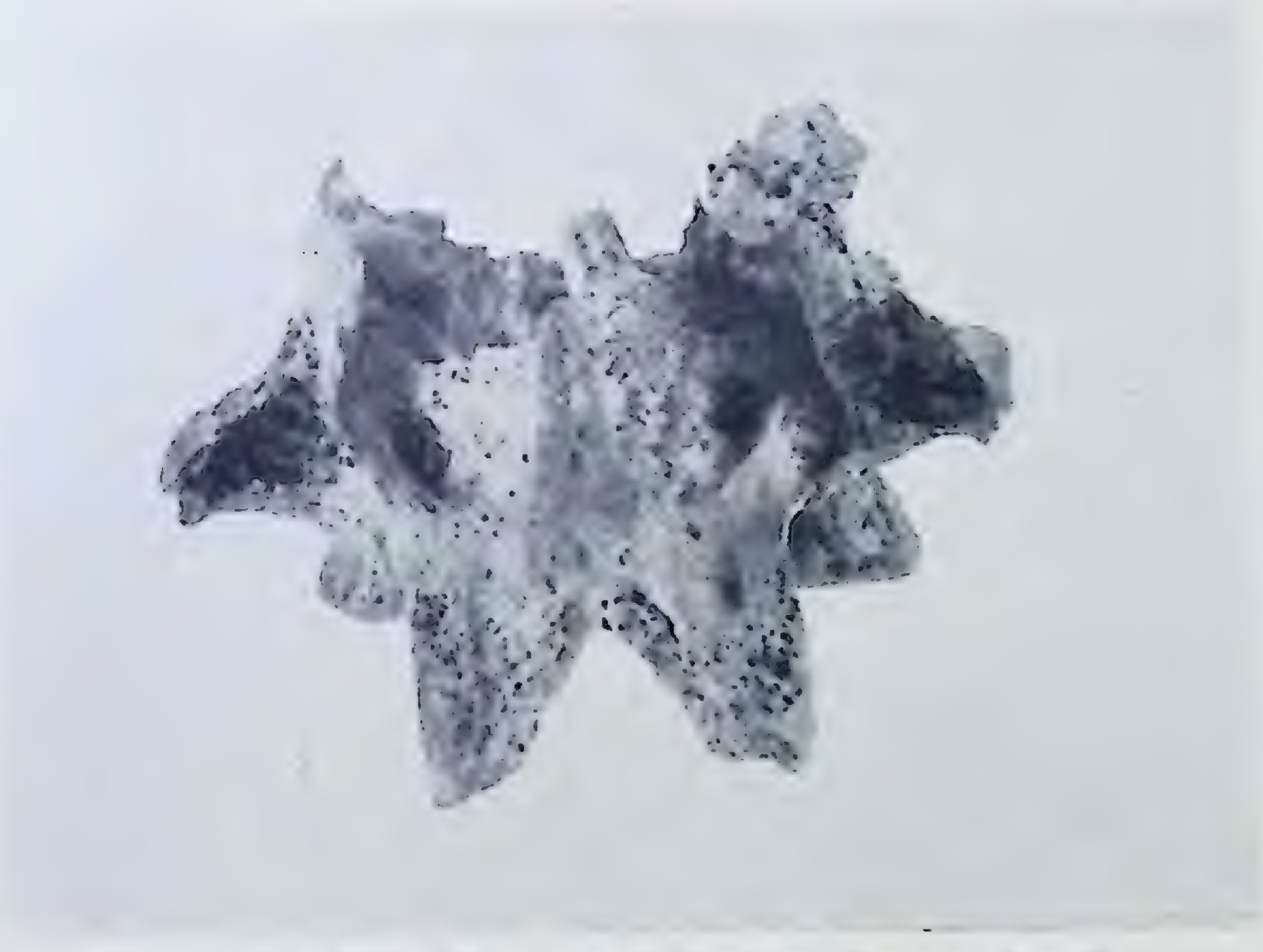
A. Osteoporosis of the vertebral body. Left: Fifth Cervical Vertebra. Right: Seventh Cervical Vertebra. Female—Age 39.



B. Osteoarthritis. Left: Fourth Cervical Vertebra. Right: Third Cervical Vertebra. Male—Age 36.

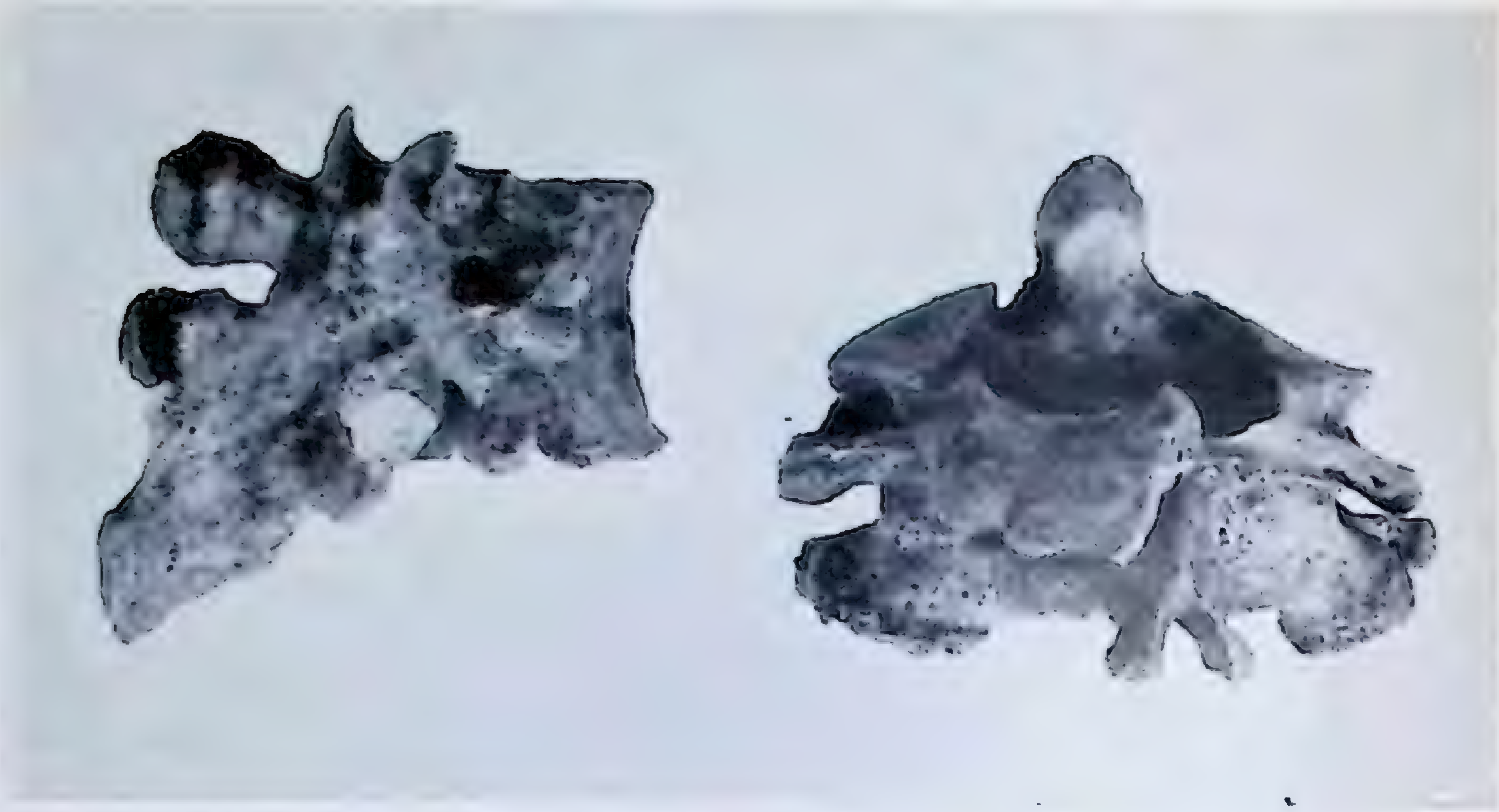


A. Osteoarthritis. Left: Fourth Cervical Vertebra. Right: Second Cervical Vertebra. Female—Age 39.

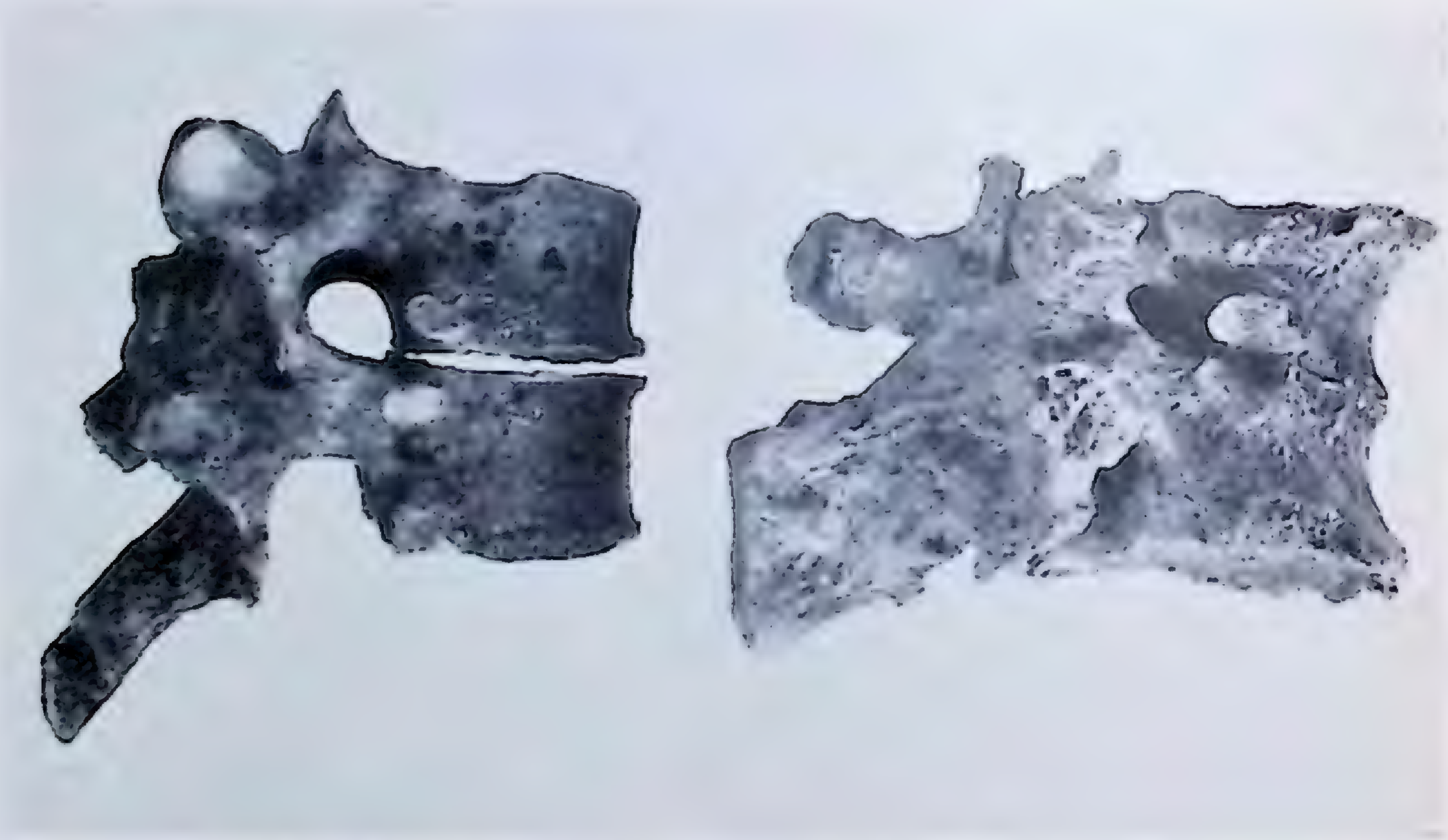


B. Laminal spurs. First Lumbar Vertebra. Female—Age 26.

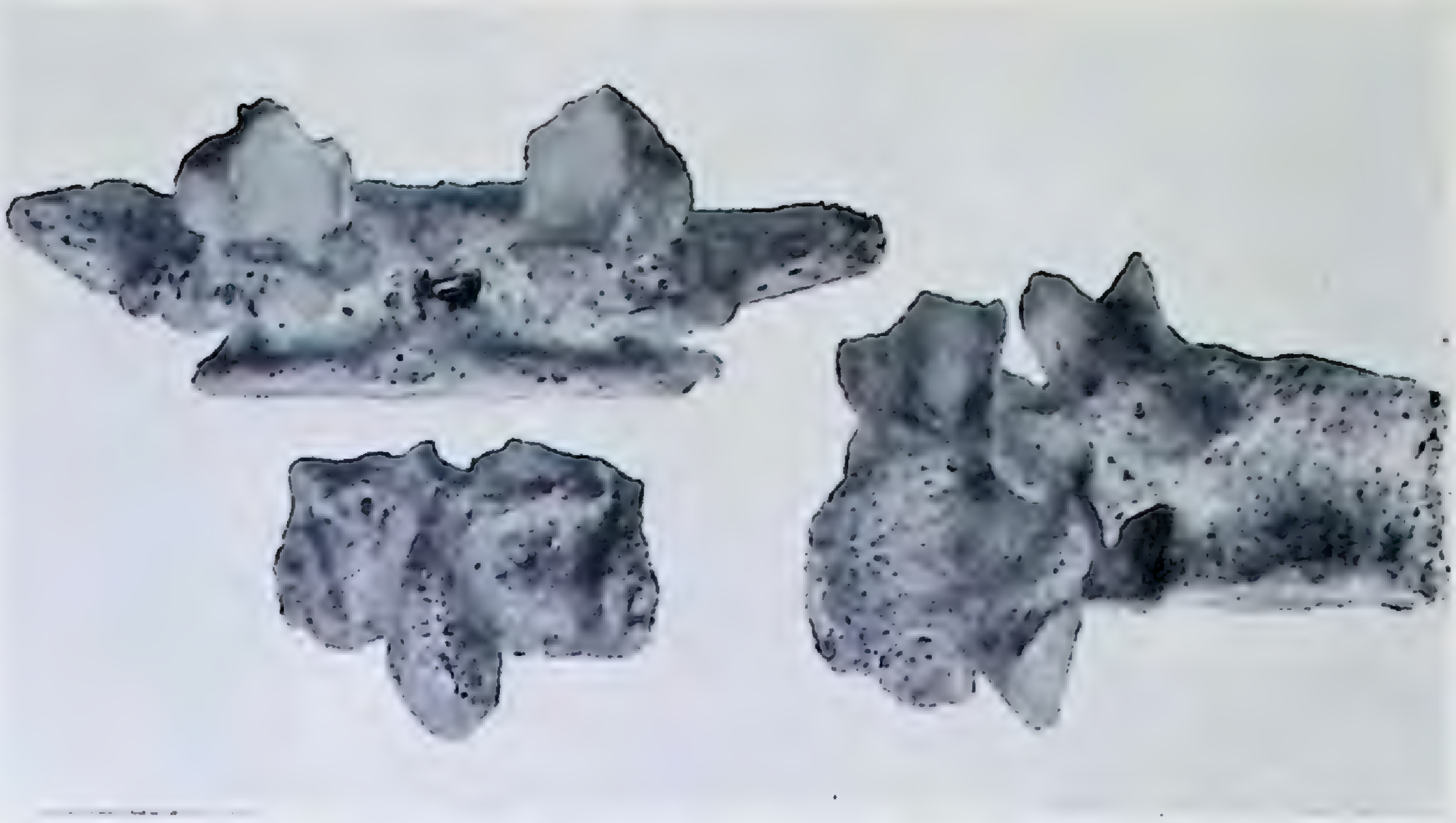
Plate IV



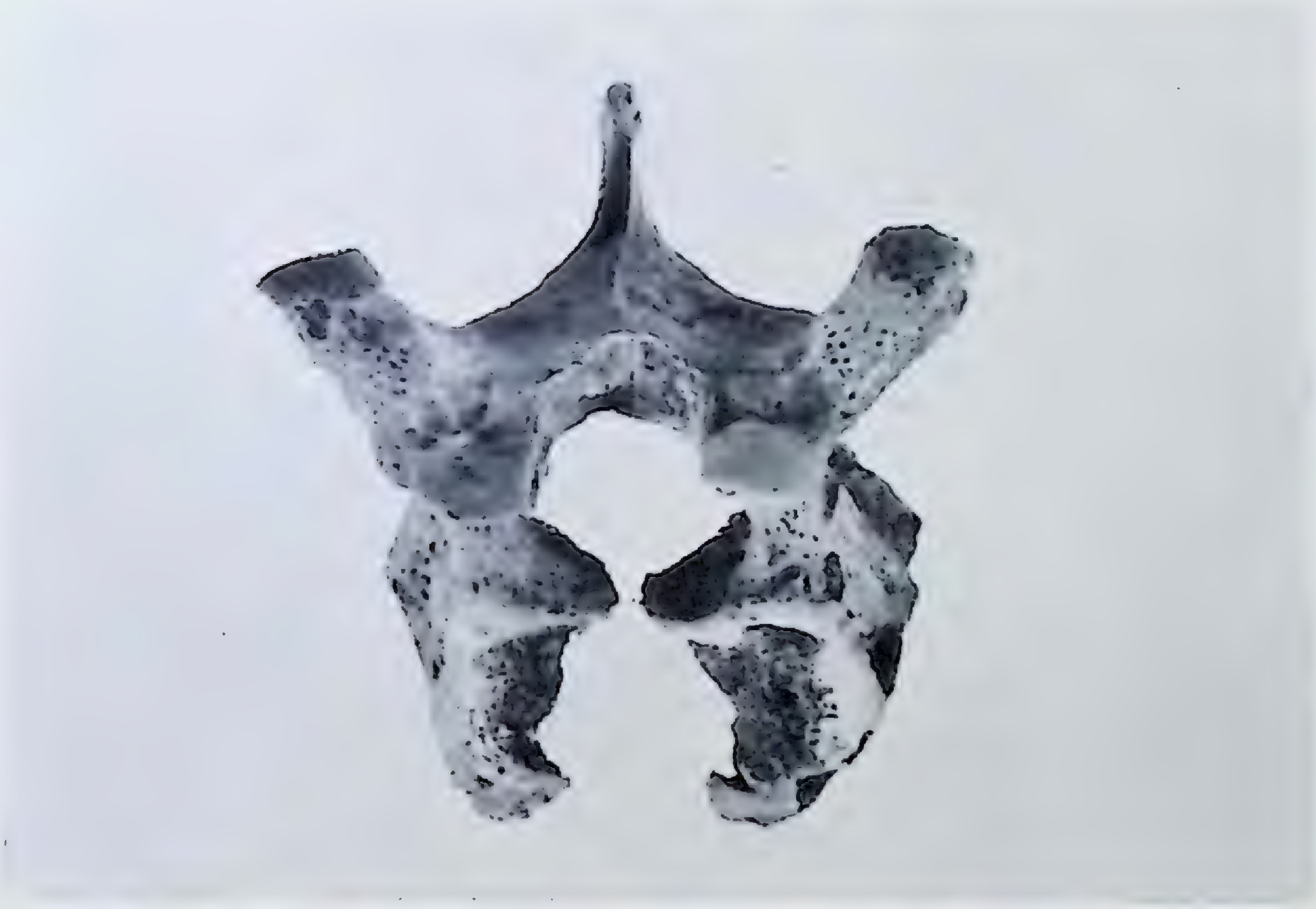
A. Vertebral fusion. Left: Third and Fourth Thoracic Vertebrae. Female—Age 34. Right: Second and Third Cervical Vertebrae. Male—Age unknown.



B. Vertebral fusion. Left: Sixth and Seventh Thoracic Vertebrae. Female—Age 38. Right: Eighth and Ninth Thoracic Vertebrae. Female—Age 34.

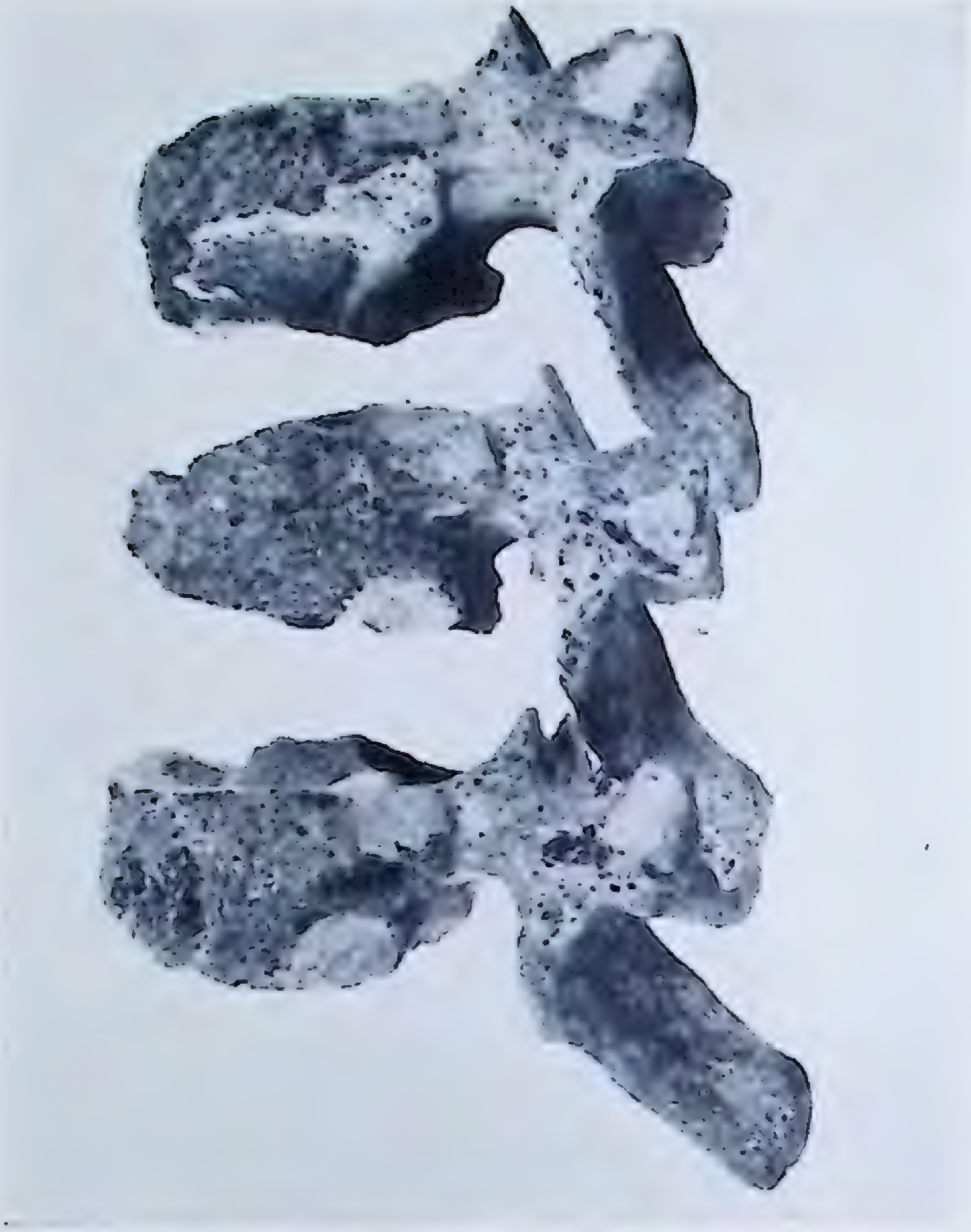


A. Spondylolysis. Left: Complete bilateral separation. Fourth Lumbar Vertebra. Right: Complete separation on right side. First Lumbar Vertebra. Male—Age unknown.

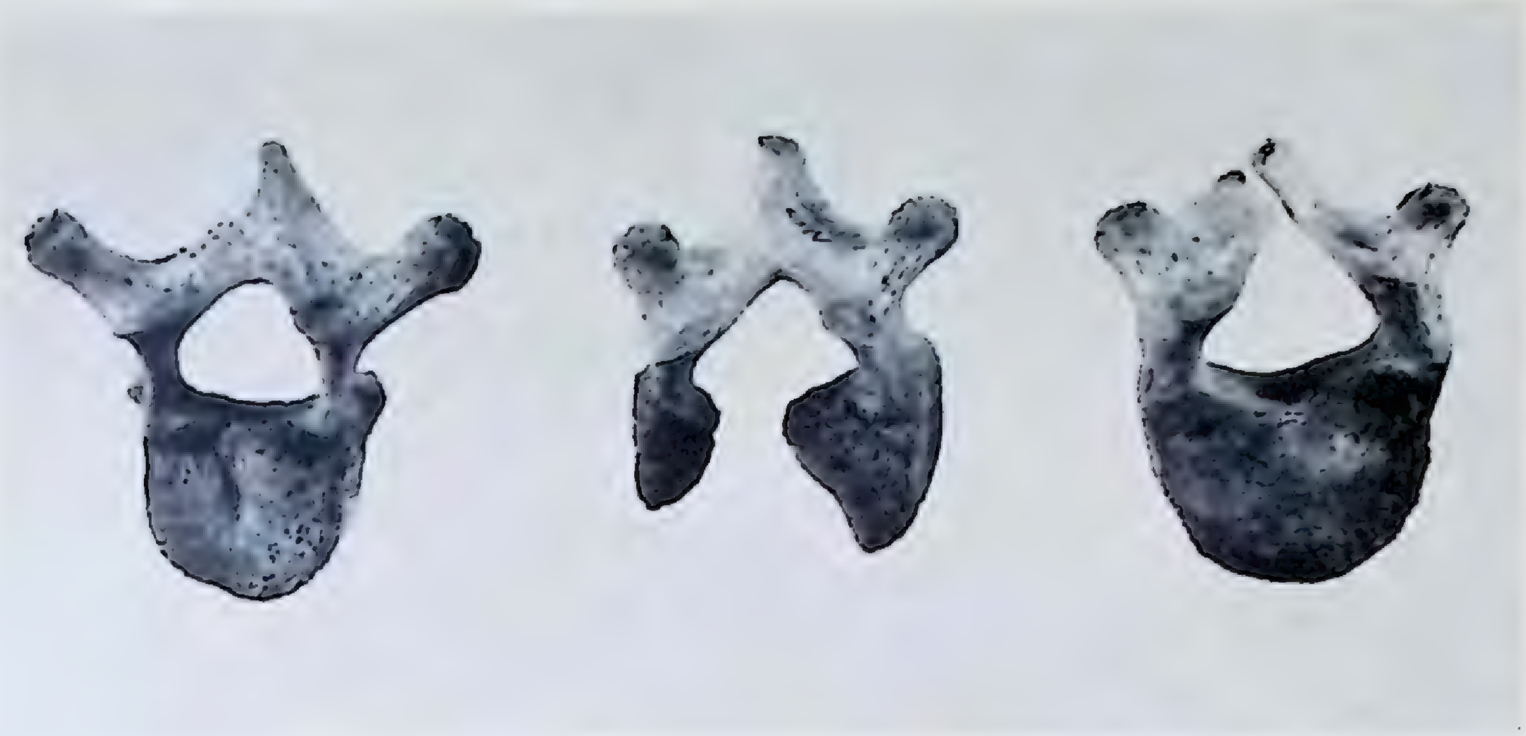


B. Incomplete Centrum. Seventh Thoracic Vertebra. Female—Age 37.

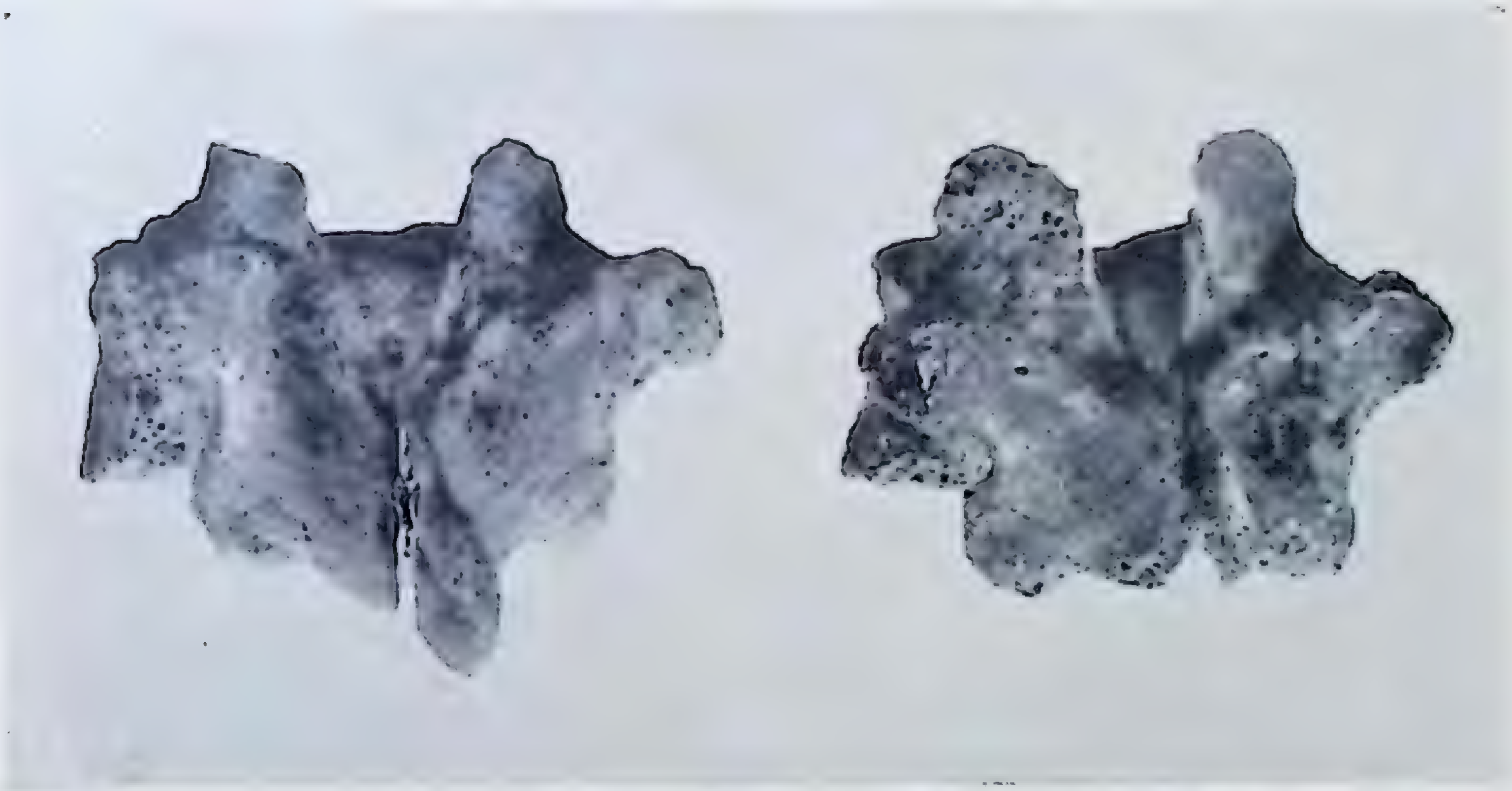
PLATE VI



Incomplete Centrum. Centre: Seventh Thoracic Vertebra showing incomplete Centrum. Top and Bottom: Sixth and Eighth Thoracic Vertebrae showing partial compensation for defect. Female—Age 37.

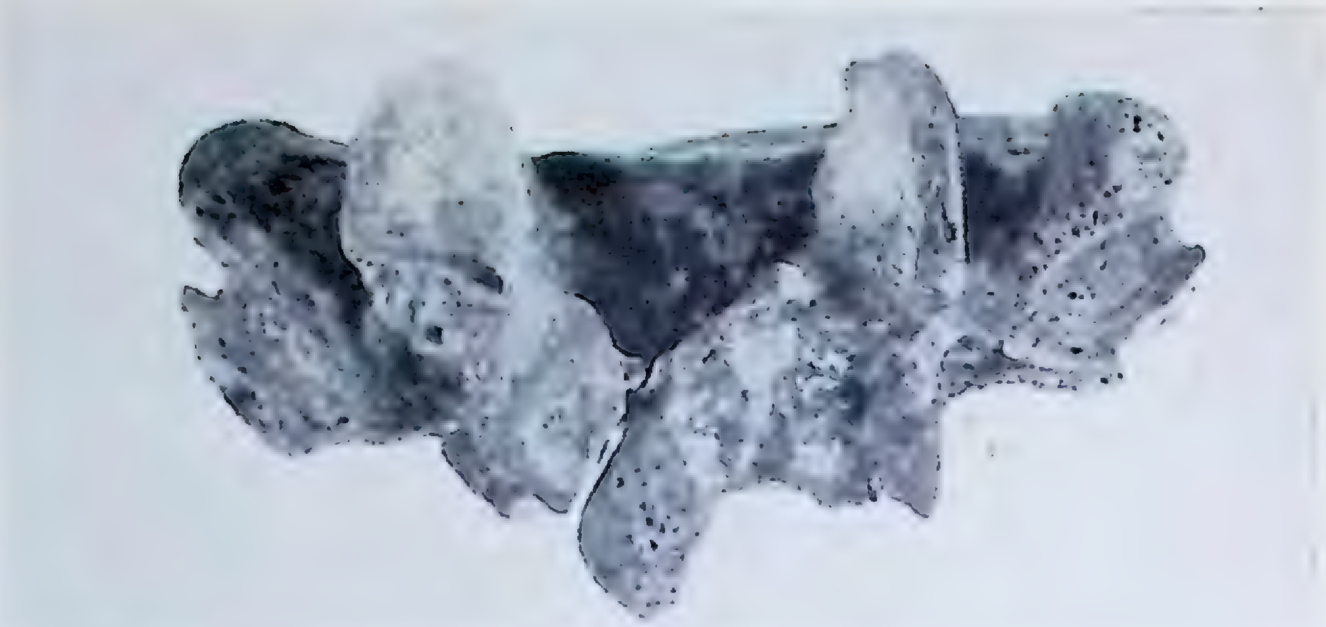


A. Cleft Centrum, incomplete Centrum, and Spina Bifida. Left: Eighth Thoracic Vertebra showing Cleft Centrum. Centre: Tenth Thoracic Vertebra showing incomplete Centrum. Right: Eleventh Thoracic Vertebra showing Spina Bifida. Sex unknown—Age 6.

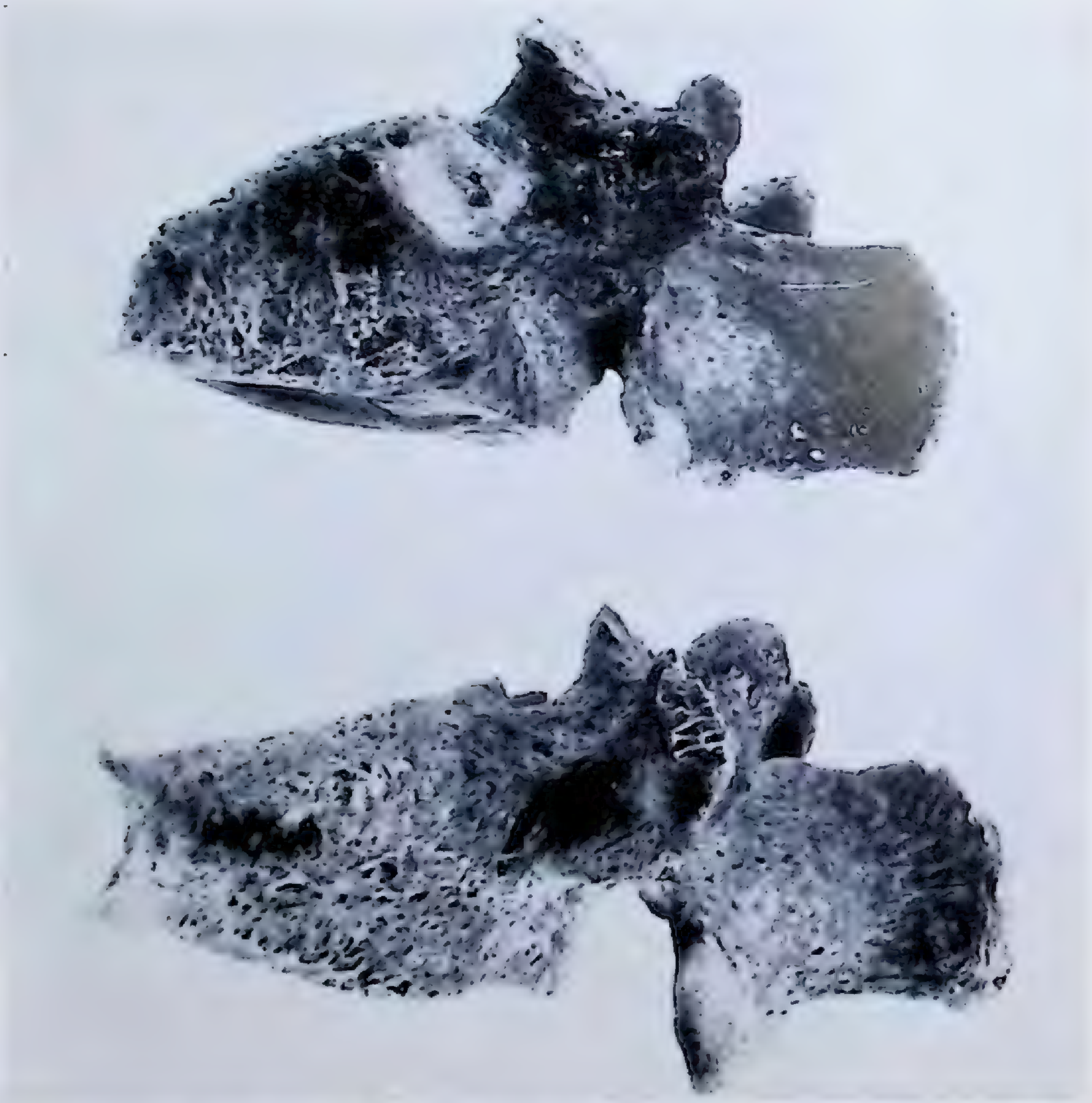


B. Spina Bifida. Left: Eleventh Thoracic Vertebra. Female—Age 25. Right: Eleventh Thoracic Vertebra. Female—Age 40.

PLATE VIII



A. Spina Bifida. Sixth Lumbar Vertebra (Lumbarized Sacral Unit). Male—Age 27.



B. Compression fractures. Top: Twelfth Thoracic Vertebra. Bottom: First Lumbar Vertebra. Male—Age 43.

THE BLOOD GROUP AND SECRETOR GENES OF THE ESKIMO ON SOUTHAMPTON ISLAND

By Bruce Chown and Marion Lewis*

This report deals with a blood group survey carried out in June, 1959, of the resident natives of Southampton Island (lat. 65°N., long. 85°W.) lying toward the north end of Hudson Bay in Canada. The purpose of the study was threefold: it was, first, part of a continuing study, under the aegis of the National Museum of Canada, of the constituent populations of Canada; secondly, a particular continuation of a study of the Eskimo aimed at throwing light on their genetic history; thirdly, a first essay in a proposed long-term study envisaged by Prof. W. S. Laughlin, University of Wisconsin, of genetic variations that in time take place in small isolates.

At the time of our visit there were 215 residents ethnologically classified as Eskimo; 203 were available for the study. They are members or descendants of two groups of Eskimo brought to the island after the previous inhabitants, the Sadlermiut, died out in 1902–3; that is, of a group of Aivilik brought around 1908 from the Repulse and Wager Bay areas on the northwest coast of Hudson Bay, and of a group of Okomiut brought via Coats Island from southern Baffin Island and the south coast of Hudson Strait about 1924.

Through Mr. V. F. Valentine of the Department of Northern Affairs and National Resources, we had been supplied with a tentative genealogy of the islanders. This was daily refined by questioning each adult through Mrs. Tom Crawford, wife of the Hudson's Bay Company manager. The final genealogies covered five generations for each of the two subpopulations. These, stripped to persons tested and to key figures in the older generations so as to show relationships, are set out in Figures 1 and 2. From the history so obtained, from their physical features, and from the blood groups, it was evident that the Aivilik had much more white blood than did the Okomiut; 62 of the 109 Aivilik tested have recorded white ancestry, 6 of the 94 Okomiut. Furthermore, the Okomiut so far have tended to retain their relative genetic purity and eschew marriage with people of mixed blood. There have been only three marriages between the two Eskimo groups, and in these three instances an Okomiut took a pure-blood rather than a mixed-blood Aivilik for a mate. This is possibly a passing phase. In part it may be due to each group, living in different but nearby settlements, regarding the other as "strangers"; in part to the fact that some of the old Eskimo arts are still important to survival. A woman who is adept at such arts is more likely to be pure-blood than hybrid.

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*Rh Laboratory, University of Manitoba, 735 Notre Dame Ave., Winnipeg 3 (postal address).

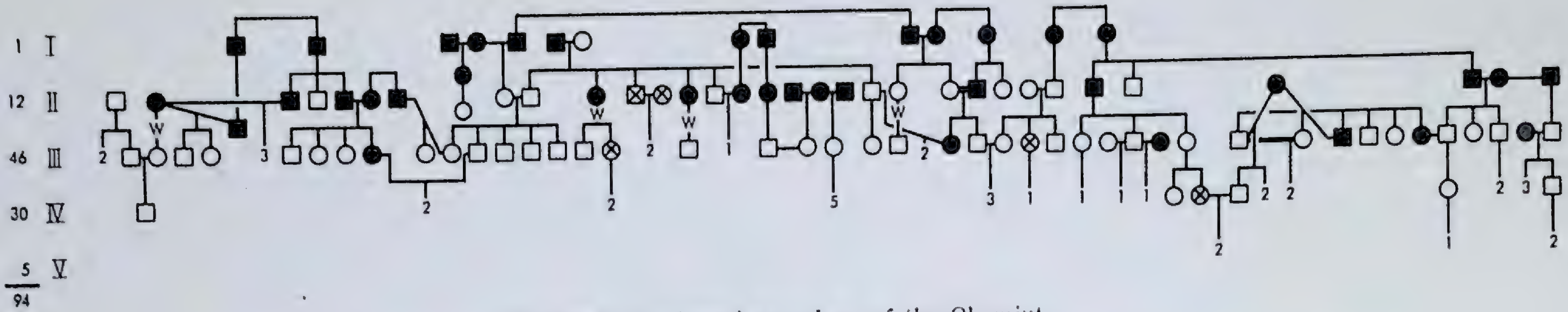

Figure 1. Condensed genealogy of the Okomiut.

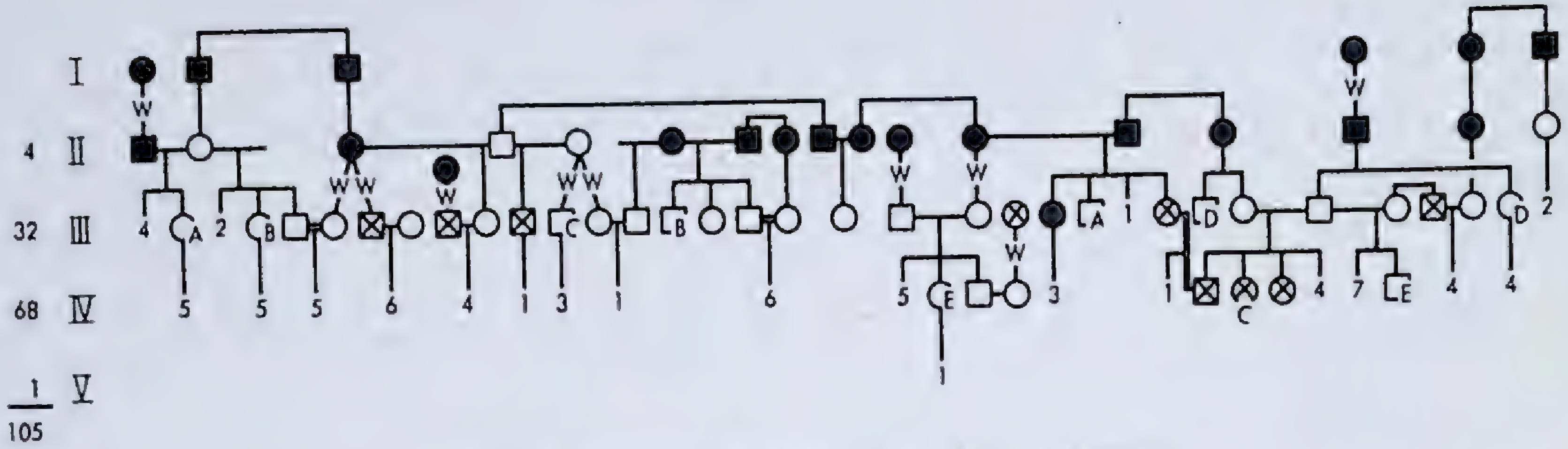

Figure 2. Condensed genealogy of the Aivilik.

To conserve space and simplify the genealogies, we have indicated (1) the white father of a child by placing the letter "W" between the child and its mother; (2) the number of unmarried children of a mating by a number; (3) the childless married children individually, but have not indicated to whom they were married. A heavy line=consanguinity between mates.

Code. ■ ● Dead
□ ○ Living, not tested
☒ ⊗ Tested
□A ○A These symbols are used in Figure 2 for husband and wife far apart on the pedigree, both of whom were tested if living. Children shown as descended from the wife except "C," the wife being dead.

Matings between cousins are not banned: in the Aivilik in generation III, three of the twenty matings are between cousins; in the Okomiut there is one cousin mating in generation II. It will be seen in the Okomiut genealogy (Figure 1) that one man (III-37) is married to his niece who is also his step-daughter. Polygynous matings occurred more commonly in the past, than now; in the present population only one man maintains two wives.

Results of the Study and their Analysis; Relationship to Other Eskimo

The phenotype frequencies are set out in Tables 1, 3, and 4; the estimated gene frequencies in Table 2. These data do not allow a statement of the relationship of these to other Eskimo populations that have been

TABLE 1. *Observed frequencies of phenotypes*

Blood group system	Observed phenotypes	Aivilik		Okomiut	
		Number	Percentage	Number	Percentage
ABO	O	36	.330	39	.415
	A_1	67	.615	54	.575
	A_2	6	.055	1	.010
	Totals	109	1.000	94	1.000
MNSs	M	45	.413	53	.564
	MN	55	.505	37	.394
	N	9	.082	4	.042
	Totals	109	1.000	94	1.000
	S	6	.055	0	.000
	Ss	18	.165	10	.107
	s	85	.780	83	.893
	Totals	109	1.000	93	1.000
	MS	6	.055	0	.000
	MSs	4	.037	7	.075
	Ms	35	.321	45	.484
	MNS	0	.000	0	.000
	MNSs	12	.110	3	.032
	MNs	43	.395	34	.366
	NS	0	.000	0	.000
	NSs	2	.018	0	.000
	Ns	7	.064	4	.043
	Totals	109	1.000	93	1.000

TABLE 1. *Observed frequencies of phenotypes*—Concluded

Blood group system	Observed phenotypes	Aivilik		Okomiut	
		Number	Percentage	Number	Percentage
P	P+	72	.686	54	.628
	P−***	33	.314	32	.372
	Totals	105	1.000	86	1.000
Rh	C+c−D+E−e+	58	.532	36	.383
	C−c+D+E+e−	3	.028	12	.128
	C+c+D+E+e+	25	.229	45	.479
	C+c+D+E−e+	15	.138	1	.010
	C−c+D+E+e+	8	.073	0	.000
	Totals	109	1.000	94	1.000
Kell	K−k+ Kp(a−b+)	105	.963	92	.979
	K+k+ Kp(a−b+)	4	.037	0	.000
	K−k+ Kp(a+b+)	0	.000	2	.021
	Totals	109	1.000	94	1.000
Duffy	Fy(a+b−)	52	.477	68	.756
	Fy(a+b+)	52	.477	21	.233
	Fy(a−b+)	5	.046	1	.011
	Totals	109	1.000	90	1.000
Kidd	Jk(a+)	75	.862	57	.877
	Jk(a−)	12	.138	8	.123
	Totals	87	1.000	65	1.000
Lewis	Le(a−b+)	88	.898	79	.940
	Le(a−b−)	2	.020	1	.012
	Le(a+b+)*	8	.082	4	.048
	Totals	98	1.000	84	1.000
	Yt(a+)**	36	1.000	39	1.000

*These persons were all under one year of age. Not all infants reacted as Le(a+b+).

**Only group O persons were tested.

***30 group O P− persons were tested with anti-Tj^a; all were Tj(a+).

studied in the same way; the population size is too small, and each population is derivative of a very small ancestral group, whereas the Aivilik group is markedly hybrid. One may well question whether, because of these facts,

TABLE 2. *Calculated gene frequencies*

Blood group system	Gene product	Population	
		Aivilik	Okomiut
ABO	O	.575	.644
	A_1	.379	.348
	A_2	.046	.008
MNSs	M	.665	.761
	N	.335	.239
	S	.138	.054
	s	.862	.946
	MS	.105	.054
	Ms	.560	.707
	NS	.033	.000
	Ns	.302	.239
P	P_1	.439	.390
	P_2 + p	.561	.610
Rh	CDe + Cde	.716	.628
	cDE + cdE	.179	.367
	cde + cDe	.105	.005
Kell	K^b	.018	.000
	k^a	.000	.011
	k^b	.982	.989
Duffy	Fy^a	.716	.872
	Fy^b	.284	.128
Kidd	Jk^a	.629	.649
	Jk^b	.371	.351

TABLE 3. *Antigens apparently lacking* (i.e., *not demonstrated*) *in total population*

System	Antigen	Number tested (all negative)
MNSs	M^g	193
	Mi^a	193
	Vw	193
Rh	C^w	203
	V	203
Diego	Di^a	203
Berens	Be^a	203
Wright	Wr^a	203
Sutter	Js^a	107*
Lutheran	Lu^a	74**

*Persons omitted from this test were the offspring of parents both of whom were tested.

**Only group O persons were tested.

TABLE 4. *Lewis groups and secretor tests*

Lewis type	Sec. of appropriate ABH		Non-sec. of appropriate ABH	
	Aivilik	Okomiut	Aivilik	Okomiut
Le(a−b+)	86	75	0	0
Le(a−b−)	1	1	1	0
Le(a+b+)*	6	3	0	0

This table includes only those people who were tested for both Lewis groups and Secretor status. Saliva samples were not obtainable from some persons.

*All children under one year of age.

a more detailed analysis of the data is justifiable. Nevertheless, keeping these reservations in mind, we have made certain comparisons. The comparisons are presented in Tables 5 and 6.

TABLE 5. *Comparison of subpopulations of Aivilik*

Phenotype	"Pure-blood"	Hybrid	X_2	d.f.	p.
O	17	18	3.50	2	<.20>.10
A_1	26	39			
A_2	0	6			
M	26	18	11.87	1	<.01
MN	16	37			
N	1	8			
S	0	6	12.66	1	<.01
Ss	2	15			
s	41	42			
P+	18	53	21.41	1	<.01
P−	23	8			
C+c−D+E−e+	29	27	11.00	2	<.01
C−c+D+E+e−	2	1			
C+c+D+E+e+	8	16			
C+c+D+E−e+	4	11			
C−c+D+E+e+	0	8			
Fy(a+b−)	35	16	32.58	1	<.01
Fy(a+b+)	7	45			
Fy(a−b+)	1	2			
Jk(a+)	28	43	1.85	1	<.20>.10
Jk(a−)	2	9			
K+k+Kp(a−b+)	0	4			
K−k+Kp(a−b+)	43	59			

There is a statistically significant difference between the two in all blood group systems save ABO and Kidd (Jk). It is evident that there is a true genetic difference in the ABO and Kell systems since A_2 and K^b are white genes.

TABLE 6. *Comparison of "Pure-blood" Aivilik and "Pure-blood" Okomiut*

Phenotype	Aivilik	Okomiut	X^2	d.f.	p.
O	17	35	0.00	1	n.s.
A_1	26	52			
M	26	48	0.59	1	n.s.
MN	16	34			
N	1	4			
S	0	0	0.87	1	n.s.
Ss	2	8			
s	41	78			
P+	18	47	2.64	1	.10
P−	23	32			
C+c−D+E−e+	29	34	21.33	2	.01
C−c+D+E+e−	2	11			
C+c+D+E+e+	8	42			
C+c+D+E−e+	4	0			
Fy(a+b−)	35	63	0.93	1	n.s.
Fy(a+b+)	7	19			
Fy(a−b+)	1	1			
Jk(a+)	28	52	0.32	1	n.s.
Jk(a−)	2	6			

There is no statistically significant difference between the two, save in the Rh system.

On the genetic forces involved. Of the four genetic forces that might account for the above differences—mutation, selection, racial mixing, and random drift—one can certainly rule out mutation as having played a measurable part. As to selection it is probably true that no gene is absolutely neutral in survival value, and it is known there is selection for or against some of the blood group genes (for example, against *O* by duodenal ulcer, at least in the industrialized West; against *A*, *B*, and a number of other genes by haemolytic disease of the newborn). However, we have no certain knowledge of the direction or strength of selection for any blood group gene in native populations such as the Eskimos, whether that gene is native to it or introduced from another population. Racial mixing has certainly played a part. From the Tables one can deduce that the white ancestors of the Aivilik introduced A_2, K^{b}_2 and probably *NS*, and likely had higher frequencies of *P*, *cde+cDe*, and Fy^{b}, and a lower frequency of *CDe+Cde* than did their Eskimo ancestors. The Okomiut received A_2 and probably k^{a} from Whites, but hybridization is not great enough to reveal much about the other genes.

The comparative frequencies of the Rh genes between the "pure-blood" Okomiut and the "pure-blood" Aivilik, and between these and other Eskimo we have studied (1, 2, and unpublished) cannot be so explained. The frequencies for these and for an average white population are as follows:

	A Other Eskimo	B Average White	C "Pure-blood" Okomiut	D "Pure-blood" Aivilik
CDe+*Cde*	49.5	42	63.22	81.40
cDE+*cdE*	49.5	15	36.78	13.95
cde+*cDe*	1.0	43	0.00	4.65

In C and D the frequencies diverge, and diverge in the same direction, from the frequencies in our earlier studies. Simple mixing of some B into A could not produce C or D. If the frequency of *cde*+*cDe* in the "pure-blood" Aivilik represents the introduction of white genes from unknown white ancestors, then the frequency of *CDe*+*Cde* in true full-blood Aivilik may have been even higher than 81.4 per cent. The divergence is then toward homozygosity of *CDe*+*Cde*, or, in other terms, toward fixation of these genes. The subpopulations discussed here are very small, and, since each is inbred, the gene pool at any given locus is even smaller than the population size would suggest. It is under just such circumstances that the fourth genetic force—random drift—has the greatest opportunity to come into play, so it seems wise to assume that, in the main, drift accounts for the above differences in Rh frequencies. Conversely, one should keep in mind the possibility suggested before (2, 3) that the Eskimo population of the Canadian Arctic is an amalgam of two stocks.

On drift. Drift, that is to say the chance inheritance of one allele rather than another, is indeed illustrated in an obvious way. A_2, B, $K^{b}{}_{2}$, and probably NS are not native genes of the Eskimo of the eastern Canadian Arctic. In northern Whites, who were the donors of the white genes in the populations, the first, second, and fourth of these genes are about equally frequent, around 8 per cent, the third around 5 per cent. Yet neither the Aivilik nor the Okomiut has inherited B, while both have inherited A_2 and the Aivilik NS and K^b. Or, again, although k^a is even less frequent than K^b in a white population, only the Okomiut, with fewer white ancestors than the Aivilik, have inherited k^a.

Apart from this chance inheritance of newly introduced genes, drift is also illustrated by the differences in gene frequencies between generations. We have compared generations III and IV of the two subpopulations. For the Aivilik the only statistically significant difference for phenotype or gene frequencies is in the Duffy system, and for the Okomiut in the ABO system. The figures are as follows:

		Aivilik Duffy Generation			Okomiut ABO Generation	
Phenotype	Assumed Genotype	III	IV	Phenotype	III	IV
Fy(a+b−)	$Fy^a.Fy^a$	18	30	O	25	3
Fy(a+b+)	$Fy^a.Fy^b$	11	38	A	21	27
Fy(a−b+)	$Fy^b.Fy^b$	3	0			

It is interesting that in each case only one of the seven blood group systems examined shows measurable drift.

DISCUSSION

This study fulfils its first two purposes by simply putting on record data that may later be extended and, we would hope, collated with other data. As to the third purpose—the study of genetic variations that take place with time in small isolates—even these seemingly isolated subpopulations are not pure isolates, and we would guess that within a generation or two what isolation there now is will have disappeared. As we have said, marriages between the groups have already taken place. In the spring of 1959 two girls were brought from the west coast of Hudson Bay to be brides of two Aivilik men. One or two wives have come from more remote places. A number of the young men now find employment at a distance from the island, and several families moved, at least temporarily, to Rankin Inlet on the west coast of the Bay in the summer of 1959. A study extended over one hundred years—five or six generations—might possibly bring to light concrete evidence of the effect of drift and of mixing on the gene frequencies here recorded, but we think it more likely that, dropped into a far larger, ever-expanding, and constantly whirling gene pool, the genes of these little populations would soon be beyond identification.

Technical Methods

Blood samples from ear punctures were collected into sterile saline, and tests carried out within five hours with the exception of twenty-three samples. Ten of these were brought to us in our laboratory through the courtesy of Prof. W. S. Laughlin; thirteen we obtained from patients in Winnipeg for medical treatment. All tests were carried out with the same anti-sera, but all persons were not completely typed, hence the difference in totals for the various blood groups.

For a description of the sera and methods used, the reader is referred to a study of the Copper Eskimo (2) from which the present study differs only in the following substitutions: anti-C+C^w (Bill), anti-C^w (kra), anti-e (D 1/40), anti-k (D 1/16) capillary papain; anti-D+C^w (shoe) capillary; anti-Le^{ab} (Dub) short albumin; and the following additions: anti-Fy^a (Wal) capillary, a saline anti-Fy^a which indicates zygosity; anti-Jk^a (Hal) indirect Coombs.

SUMMARY

A blood group genetic study was carried out on the Eskimo population living on Southampton Island in June 1959. The present population is composed of two subpopulations, the Aivilik from the west coast of Hudson Bay and the Okomiut from the shores of Hudson Strait. The former have more Caucasoid blood than the latter. As between the "pure-blood" fractions of these subpopulations, the blood group gene frequencies differ only in the Rh system. In this respect they also differ from other Eskimo populations. It is tentatively suggested that the differences may be evidence of drift. Drift or the chance introduction of one allele rather than another by white ancestors is readily illustrated in the subpopulations for the ABO, MNSs, and Kell systems. There is also measurable drift between generations III and IV of each population for one of the seven blood group systems examined.

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